Informatics I.

Ildikó Horváth

Informatics I.

Pécs

2019

The Informatics I. course material was developed under the project EFOP 3.4.3-16-2016-00005 "Innovative university in a modern city: open-minded, value-driven and inclusive approach in a 21st century higher education model".

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EFOP-3.4.3-16-2016-00005 Korszerű egyetem a modern városban: Értékközpontúság, nyitottság és befogadó szemlélet egy 21. századi felsőoktatási modellben

Informatics 1.

Ildikó Horváth PhD.

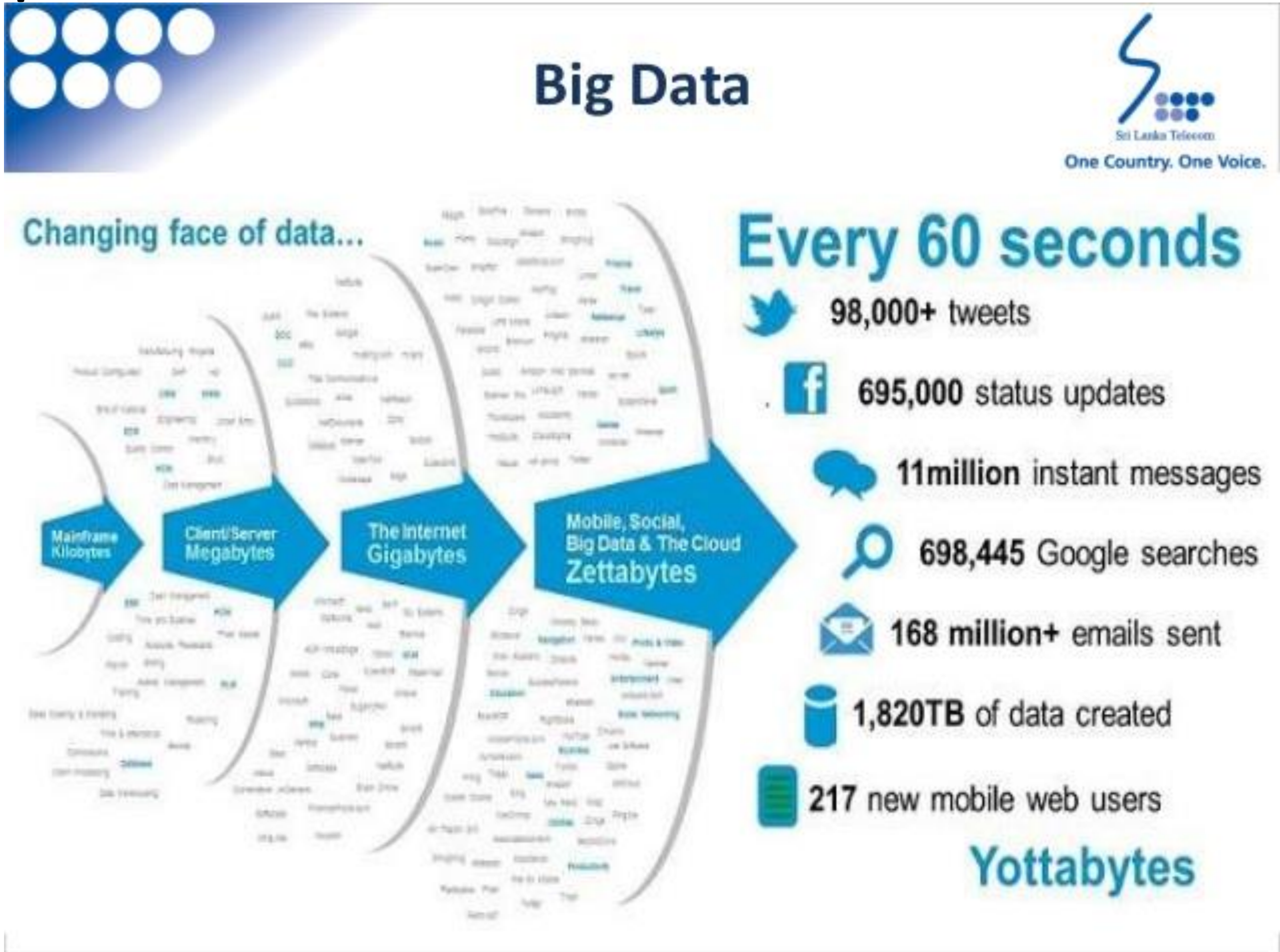
Content

- The concept of information
- The revolutions of communication
- The way of information
- The history of computers
- The Memristor
- Classification of computers
- Classification of softwares
- Microsoft Word
- Microsoft PowerPoint

Introduction

Informatics is complex

- Information
  - Gaining
  - Processing
  - Storing
  - Forwarding



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Introduction

The concept of information

- **Information** is a basic concept of **informatics**.
  There are a lot of definitions in everyday life which have it in common that information **decreases uncertainty** and **has a novelty content**, **conveys new knowledge**.

- The forms of **information** can be different. Words made up of letters and sentences with punctuation marks mean information in a book . A mark given for an oral presentation is information in the form of a number. Colours and different lines in a map also convey information.

Introduction

Unit of information

- **BIT: Short for binary digit, the smallest unit of information on a machine.
  A single bit can hold only one of two values: 0 or 1.
  More meaningful information is obtainedby combining consecutive bits into larger units.**

- **BYTE: Abbreviation for binary term, a unit of storage capable of holding a single character.**

Remark: Graphics are also often described by the number of bits used to represent each dot. The 1-bit image is monochrome; an 8-bit image supports 256 colors or grayscales; and a 24- or 32-bitgraphic supports true color.

Introduction

Unit of information

- Nibble:
  A group of four bits, or half a byte, is sometimes called a nibble or nybble. This unit is most often used in the context of hexadecimal number representations, since a nibble has the same amount of information as one hexadecimal digit.
- Crumb:
  A pair of two bits or a quarter byte was called a crumb, often used in early 8-bit computing (see Atari 2600, ZX Spectrum).
  It is now largely defunct.

Chart #1 BINARY BYTE	Is Equal To ==	byte (B)	kilobyte (KB)	megabyte (MB)	gigabyte (GB)	terabyte (TB)	petabyte (PB)	exabyte (EB)	zettabyte (ZB)	yottabyte (YB)
			kibibyte (KiB)	mebibyte (MiB)	gibibyte (GiB)	tebibyte (TiB)	pebibyte (PiB)	exbibyte (EiB)	zebibyte (ZiB)	yobibyte (YiB)
1 byte	==	1 byte	-	-	-	-	-	-	-	-
1 kilobyte	==	1024 bytes	1 KB/KiB	-	-	-	-	-	-	-
1 kibibyte										
1 megabyte	==	1048576 bytes	1024 KB/KiB	1 MB/MiB	-	-	-	-	-	-
1 mebibyte		1024^2								
1 gigabyte	==	1073741824 bytes	1048576 KB/KiB	1024 MB/MiB	1 GB/GiB	-	-	-	-	-
1 gibibyte		1024^3	1024^2							
1 terabyte	==	1099511627776 bytes	1073741824 KB/KiB	1048576 MB/MiB	1024 GB/GiB	1 TB/TiB	-	-	-	-
1 tebibyte		1024^4	1024^3	1024^2						
1 petabyte	==	1125899906842624 bytes	1099511627776 KB/KiB	1073741824 MB/MiB	1048576 GB/GiB	1024 TB/TiB	1 PB/PiB	-	-	-
1 pebibyte		1024^5	1024^4	1024^3	1024^2					
1 exabyte	==	1.152921504606847e+18 bytes	1125899906842624 KB/KiB	1099511627776 MB/MiB	1073741824 GB/GiB	1048576 TB/TiB	1024 PB/PiB	1 EB/EiB	-	-
1 exbibyte		1024^6	1024^5	1024^4	1024^3	1024^2				
1 zettabyte	==	1.180591620717411e+21 bytes	1.152921504606847e+18 KB/KiB	1125899906842624 MB/MiB	1099511627776 GB/GiB	1073741824 TB/TiB	1048576 PB/PiB	1024 EB/EiB	1 ZB/ZiB	-
1 zebibyte		1024^7	1024^6	1024^5	1024^4	1024^3	1024^2			
1 Yottabyte	==	1.208925819614629e+24 bytes	1.180591620717411e+2 KB/KiB	1.152921504606847e+18 MB/MiB	1125899906842624 GB/GiB	1099511627776 TB/TiB	1073741824 PB/PiB	1048576 EB/EiB	1024 ZB/ZiB	1 YB/YiB
1 yobibyte		1024^8	1024^7	1024^6	1024^5	1024^4	1024^3	1024^2		

Introduction

- **Data** is actually **recorded knowledge**, a sequence of signals used for representing information. All the signals which are necessary for processing or are created during it, or appear as its result are considered **data**. It may not have a novelty as it depends on who receives it.

Introduction

The term “**BIG DATA**” refers to data that is so large, fast or complex that it’s difficult or impossible to process using traditional methods. The act of accessing and storing large amounts of information for analytics has been around a long time. But the concept of big data gained momentum in the early 2000s when industry analyst Doug Laney articulated the **now-mainstream definition of big data** as **the three V’s**:

- **Volume:** Organizations collect data from a variety of sources, including business transactions, smart (IoT) devices, industrial equipment, videos, social media and more. In the past, storing it would have been a problem – but cheaper storage on platforms like data lakes and Hadoop have eased the burden.

- **Velocity:** With the growth in the Internet of Things, data streams in to businesses at an unprecedented speed and must be handled in a timely manner. RFID tags, sensors and smart meters are driving the need to deal with these torrents of data in near-real time.

- **Variety:** Data comes in all types of formats – from structured, numeric data in traditional databases to unstructured text documents, emails, videos, audios, stock ticker data and financial transactions.

BIG DATA

Introduction

<u>The 6 revolutions of communication:</u>

- **1.** The **revolution of speech** which is actually the revolution of becoming a human.
- **2. The revolution of writing** /information storing is realized, information becomes independent of human memory/ - the appearance of phonetic writing
- **3. The revolution of printing press/ the mass dissemination of information is realized/,** This completed the revolution of writing, and with its help written texts could reach masses.

Introduction

- **4. The revolution of telecommunication/ distances could become bridgeable**
  The revolution of electronic communication devices – telegraph, telephone, radio, television – which is intertwined with the revolution of the information processing of electronic computers. Due to this, **information** connections span through the globe.

Introduction

- **5. The revolution of computer/electronic information processing**
  With the appearance of the computer a new type of communication was created. Besides human-human dialogue the human-machine dialogue appeared. New opportunities of information storing and processing opened up with the help of the computer.

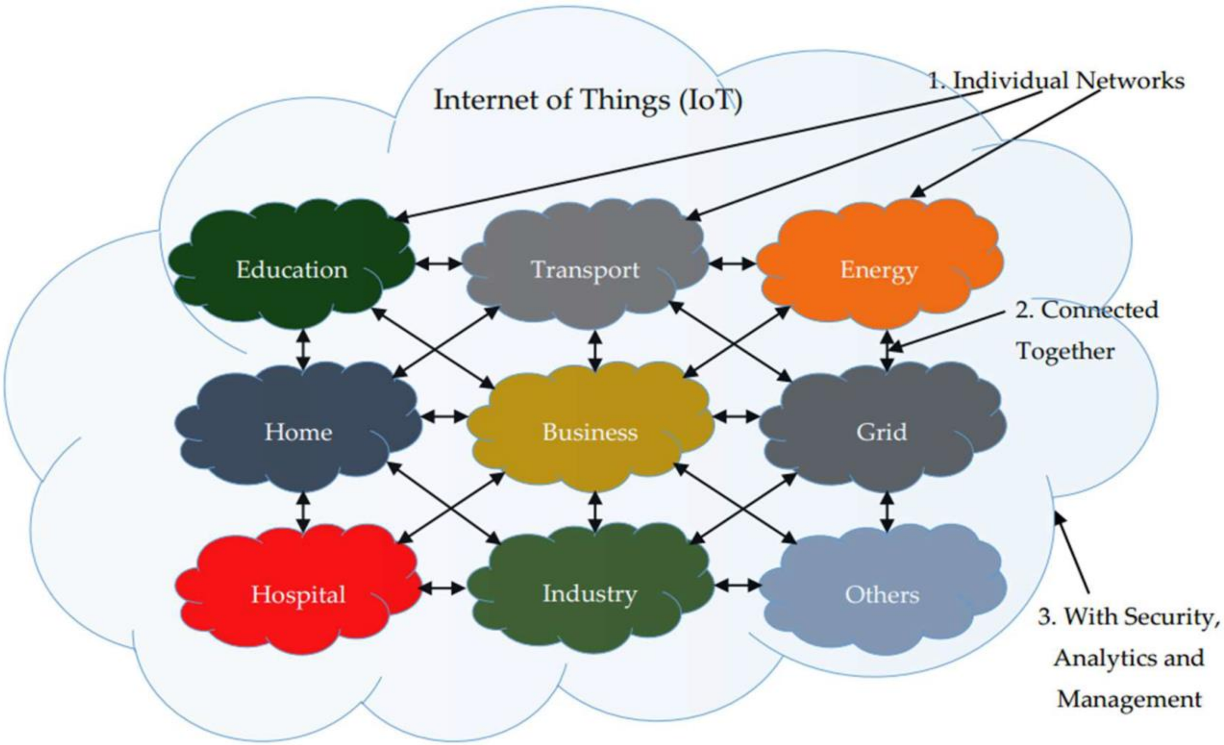
  Internet – the appearance of computer networks, more specifically of the interconnection of open systems. Internet, which is the determinate corner stone of the **information** society, is built on a new technology which connects informatics and telecommunication, changes the operation of the society, social communication.

Introduction

6. **The revolution of "Cognitive infocommunications (CogInfoCom)** The Cognitive Infocommunication investigates the link between the research areas of infocommunications and the cognitive sciences, as well as the various engineering applications which have emerged as the synergic combination of these sciences. The primary goal of CogInfoCom is to provide a systematic view of how cognitive processes can co-evolve with infocommunications devices so that the capabilities of the human brain may not only be extended through these devices, irrespective of geographical distance, but may also interact with the capabilities of any artificially cognitive system. This merging and extension of cognitive capabilities is targeted towards engineering applications in which artificial and/or natural cognitive systems are enabled to work together more effectively."

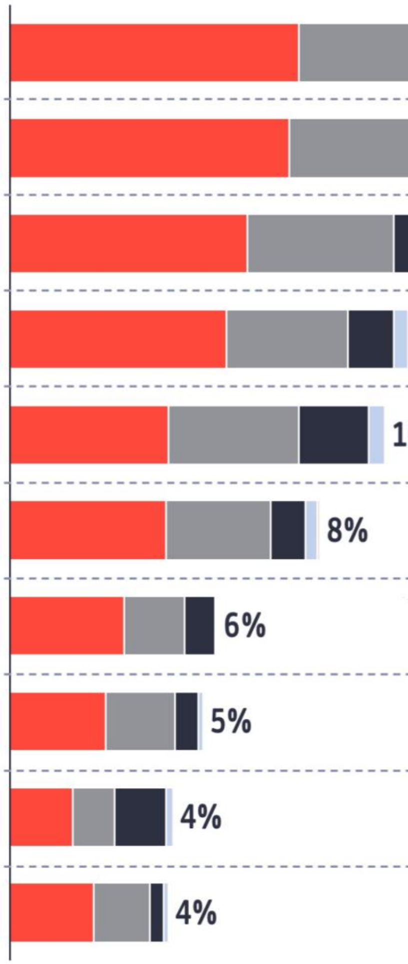
Introduction

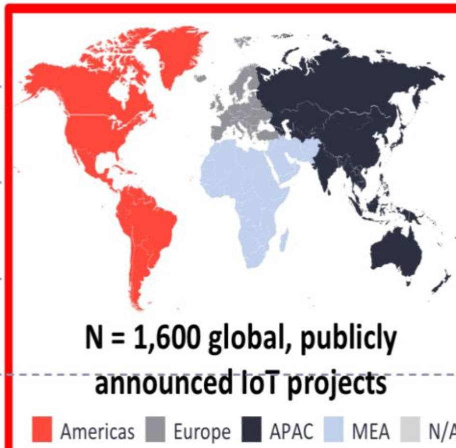
From the perspective of **global communication, Internet** has played the most important role lately and as for the future, this new medium has a key role.



Future Internet **2018**, *10*(8), 68; https://doi.org/10.3390/fi10080068

IoT Segment	Global share of IoT projects[1]	Americas	Europe	APAC	Trend[2]
1 Smart City	23%	34%	45%	18%	↗
2 Connected Industry	17%	45%	31%	20%	↘
3 Connected Building	12%	53%	33%	13%	↑
4 Connected Car	11%	54%	30%	12%	→
5 Smart Energy	10%	42%	35%	19%	→
6 Other	8%	50%	34%	11%	→
7 Connected Health	6%	55%	29%	15%	↗
8 Smart Supply Chain	5%	49%	36%	12%	↗
9 Smart Agriculture	4%	39%	26%	31%	↘
10 Smart Retail	4%	53%	35%	9%	→





N = 1,600 global, publicly announced IoT projects

1.Based on 1,600 publicly known enterprise IoT projects (Not including consumer IoT projects e.g., Wearables, Smart Home). 2.Trend based on comparison with % of projects in the 2016 IoT Analytics Enterprise IoT Projects List. A downward arrow means the relative share of all projects has declined, not the overall number of projects 3. Not including Consumer Smart Home Solutions. **Source**: IoT Analytics 2018 Global overview of 1,600 enterprise IoT use cases (Jan 2018)

Source: IoT Analytics, Jan 2018

The way of information

- The creation of information is a key process in informatics.

The information source, the **sender** prepares the statement/message with a kind of method, that is, it transforms the **information to be communicated into signals.**
Then he **sends it to the addressee**, and he **uses a transmitting medium** for this. Information has to be formed into a series of signals during coding where the medium is suitable for transmitting these. The medium „is not always noticed”, although it has a necessary role.

The way of information

- After receiving the statement, the addressee tries to get the information from the statement, to interpret the signals.
  In informatics the sender is called **transmitter,** the addressee is called **receiver.** Creating the statement is **coding**, and getting the information is **decoding**.
  The term for transmitting medium is: transmission **channel**.

Communication System

Transmitter:

- Formatting
- Source Encoding
- Encryption
- Channel Encoding
- Multiplexing
- Modulation
- Frequency Spreading

Channel:

- Copper Wires
- Coaxial cables Twisted pairs
- Optical fibres
- Atmosphere/Ionosphere

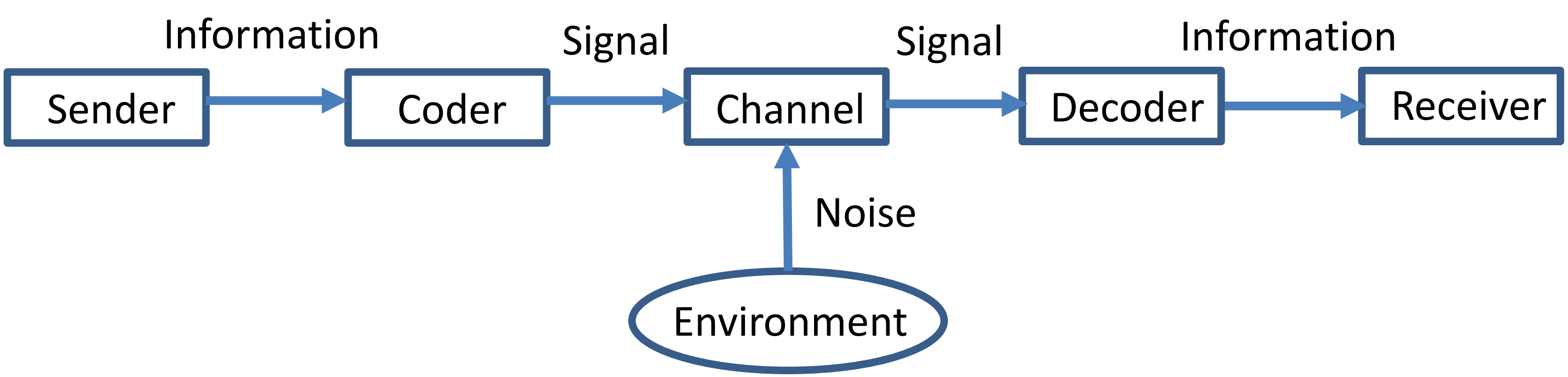
Receiver:

- Formatting
- Source Decoding
- Decryption
- Channel Decoding
- Demultiplexing
- Demodulation
- Frequency despreading

The way of information

The role of the **channel** is to **send** the coded statement/message, the signals from the transmitter to the receiver.

But **environment** also influences this channel. Effects coming from the environment can disturb transmission, so the signals to be transmitted can be distorted, can even get lost. These disturbing effects are called **noise**. In reality not only single-step coding and decoding happen.



Introduction

- Information technique
  - Informatics from the side of technical device
- Computing
  - It deals with the devices of automated data processing

Computing

- **Computing** is a theoretical and applied technical science dealing with the devices of automated data processing and their usage in different fields (e.g. building a computer and programming it).
  - Computing/Informatics is in close connection with ***informatics***, a science dealing with investigating the creation, forwarding/transmission, processing and utilization of information.

Generations of computers

- Zero generation computers – mechanical machines
(John Atanastof's machine –**captors**, DRAM, MARK I. – **relay**)
- The first computers used vacuum tubes for circuitry and magnetic drums for memory. (ENIAC-Elektronic Numerical Integrator And Computer)
- Second generation computers - **Transistors** (1961 - PDP-1,)
- Third generation computers – Integrated circuit (1965-1980 –Transistors were miniaturized and placed on siliconchips, called semiconductors.)
- Fourth generation computers – The microprocessor brought the fourth generation of computers, as thousands of integrated circuits were built onto a single silicon chip, from the central processing unit and memory to I/O controls—on a single chip.
- Fifth generation computers– AI -**Memristors**

The history of computers

Zero generation

- Calculation from the beginnings
  - People have sought since the earliest times to make devices which make calculation easier and faster.

    The first calculating devices were pebbles, pieces of wood, knots tied on ropes, trees, signs carved on the ground.

    These devices were suitable not only for calculation but also for preserving the result of calculation.

The history of computers

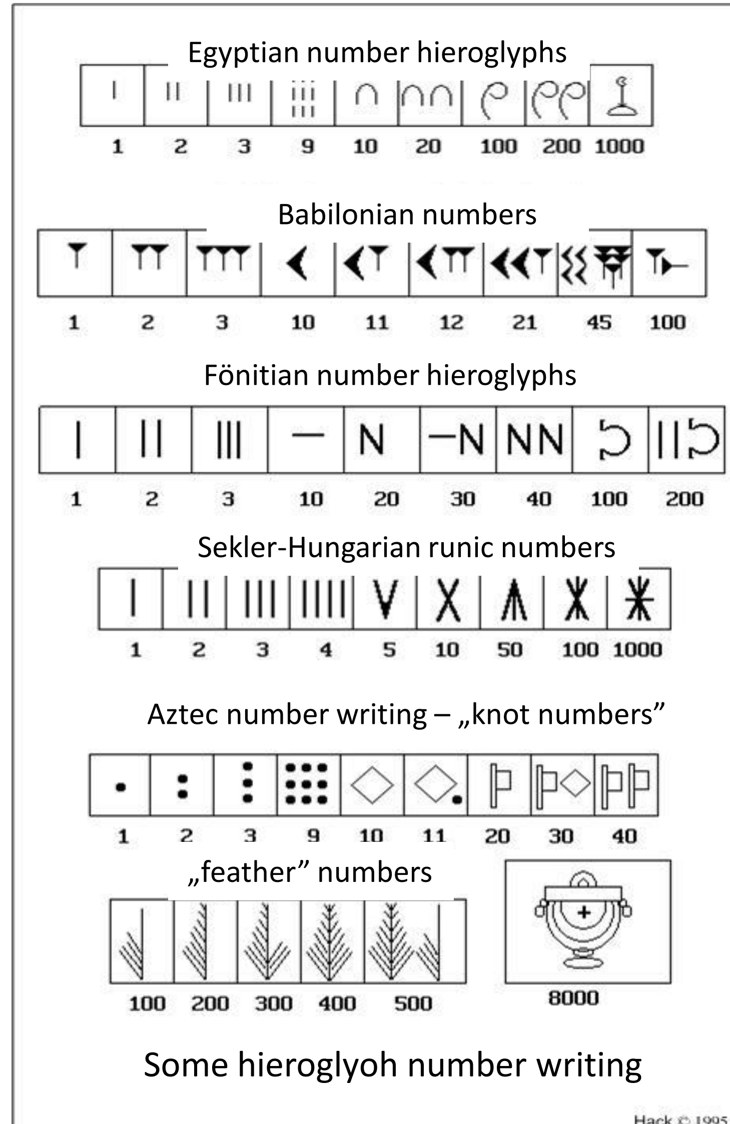
Different nations used different numeral systems and digits (signals).

The **Sumers**, then the **Babylonians** used the **sexagesimal** numeral system.

The subdivision of **time** and **angles** originate from here.

The **Chinese** calculated using sticks made of ivory.

The **Egyptians** indicated numbers with the help of hieroglyphs.



Some hieroglyoh number writing

The history of computers

New devices were needed in favour of wider spread. The first one was the **stone tablet**. **Summation** and **subtraction** of large numbers could be made easily by moving pebbles to and fro.

The history of computers

This device was **perfected** by the Romans and they created the **calculus**.. The word **calculator** evolved from the Latin equivalent of the word *pebble* throughout history. Its meaning is still a device helping calculation.

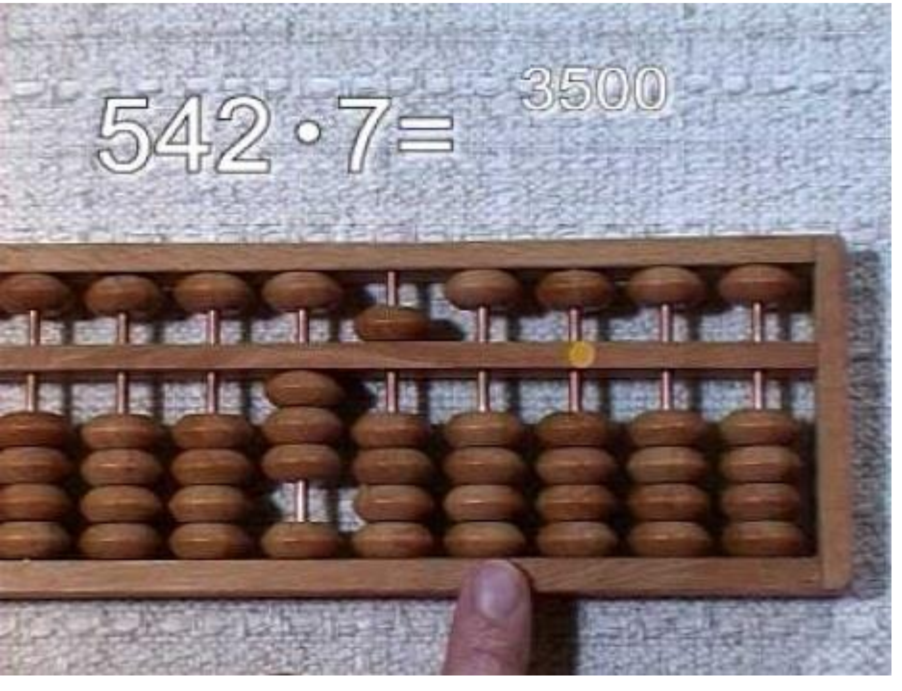
Interestingly, the word **digital** derives from the Latin word **digitus** (finger), and the word **computer** from the word **computare** (carving on runic wood).

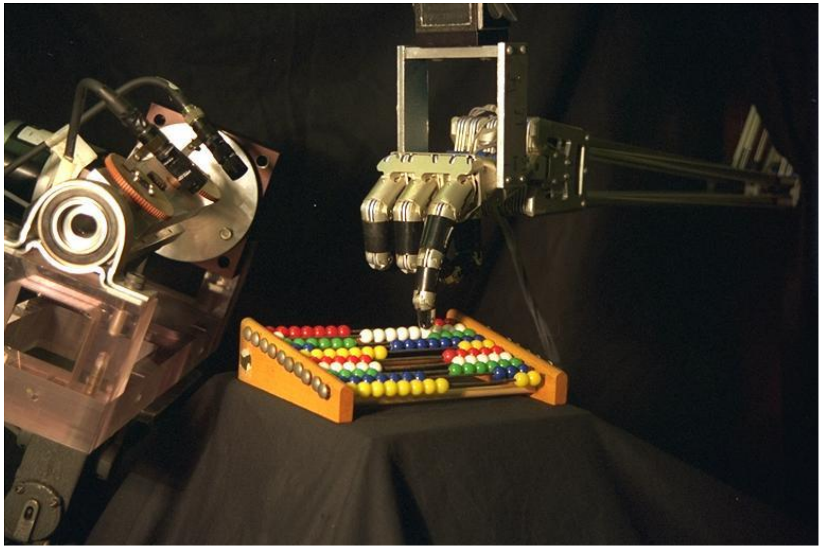
The history of computers

Devices similar to calculus were also developed in China and Japan (independently from each other). The Chinese called it **Suan Pan**, the Japanese **soroban**.

The history of computers

- The most significant step in the development of the concept of numbers was the **appearance of place value**.



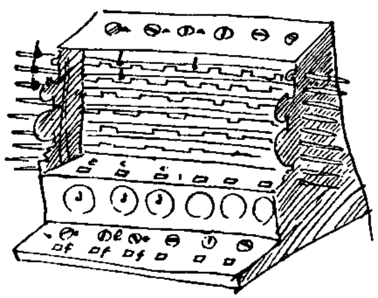


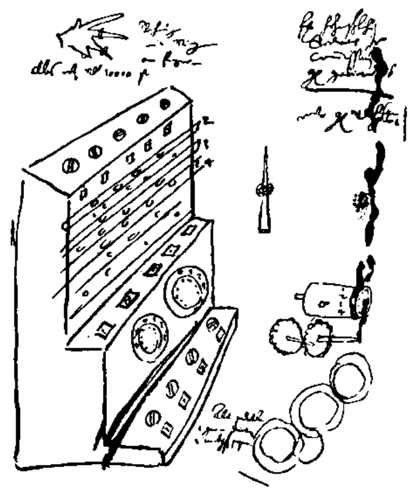
The history of computers

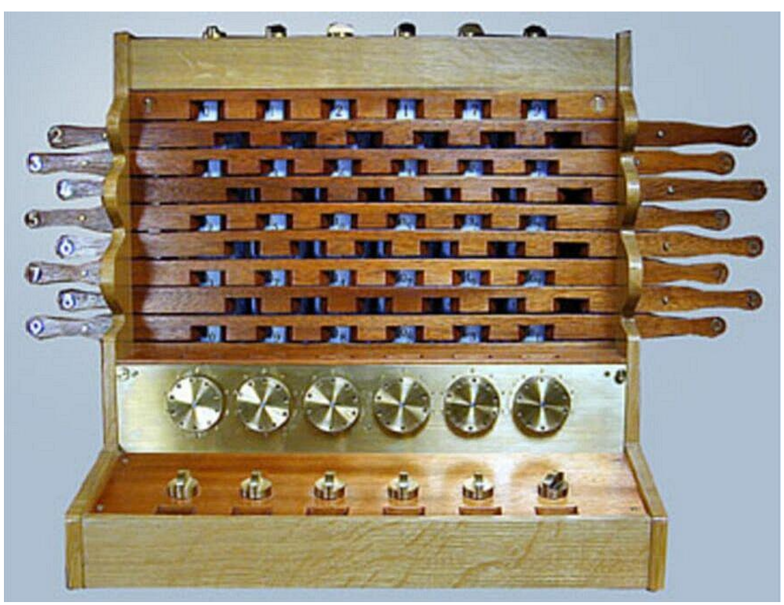
In the 17th century, several machines were made which were able to make basic operations.
There was a great need for these, among others when making nautical and astronomical maps.

Wilhelm Schikard (1592-1635) astronomer professor was an outstanding figure of this, his machince could both **divide** and **multiply**. It made calculations in a mechanical way using the combination of rods, cog wheels and an automatic transmission-making mechanism.

The history of computers







Sketches from his letter to Kepler.
The world learnt about the existence of the calculator while processing the Kepler-heritage in 1957, when Hammer, the Kepler-researcher published the letters and sketches he had found.

The history of computers

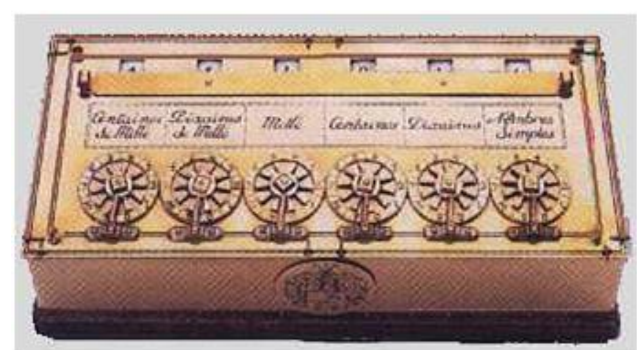
At the same time, **Napier**, a Scottish baron, developed the concept of logarithm, facilitating the deduction of multiplication to summation.

The history of computers

He himself also made a computer with which it was possible to multiply ten-digit numbers within a few seconds.

The English **Morland** and the French **Pascal** (1623-1662) made a similar machine.

Pascal's machine was the first computer „produced in series". 7 pieces were made of these.



The history of computers

He wanted to help his father - who needed to make loads of calculations of tax collection - with the machine converted from clockworks.

This machine was further developed by **Leibniz** (1646-1716) the German mathematician.

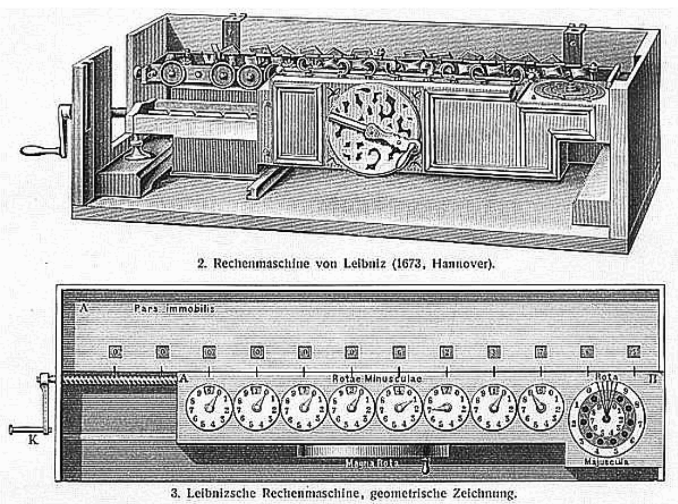
His invention **was the first one** which **directly** made **divisions** and **multiplications**.

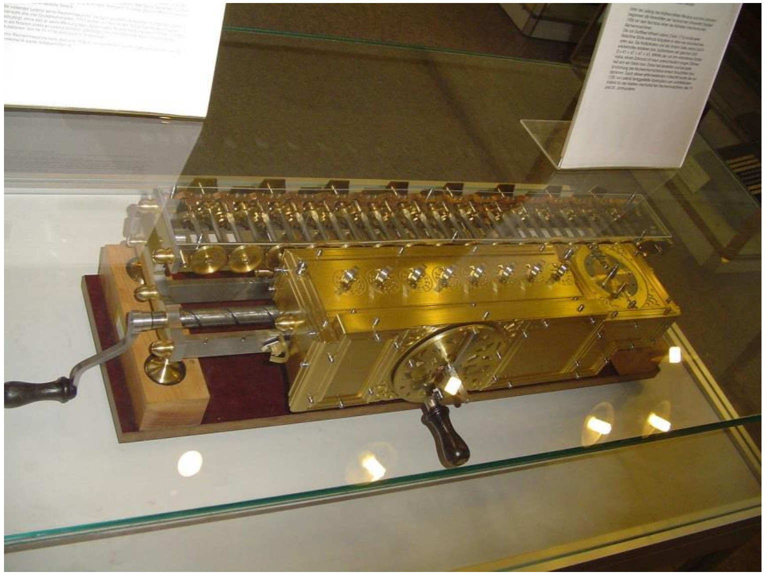
It made subtraction without supplementary operation. He **took advantage** of the fact, that **multiplication** can be **deducted** to **summation**.

The history of computers

It could achieve that **basic operations** could be made even **ten times, hundred times faster.**

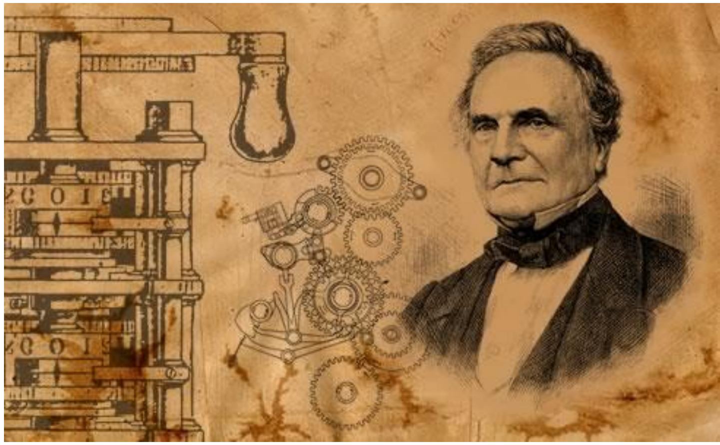
It was attributed to him that computers do **not** use **the decimal but the binary numeral system**.

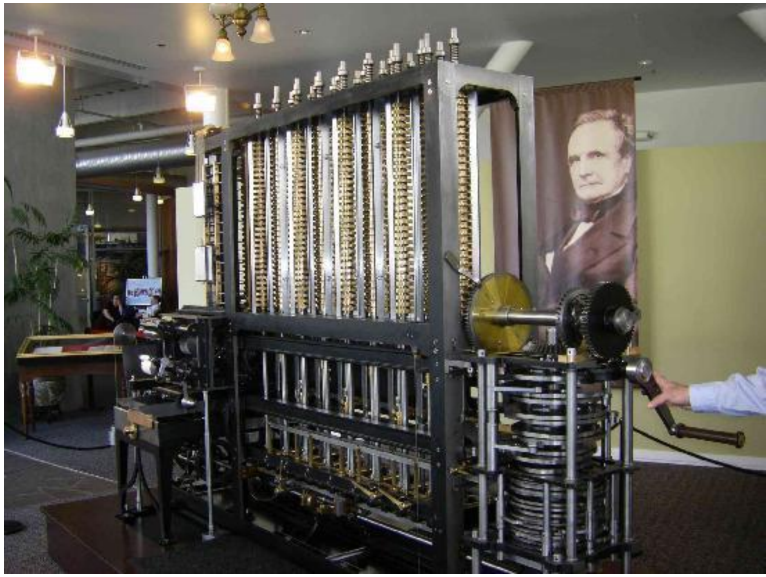




The history of computers

Babbage (1791-1871), the English mathematician astronomer was one of the great figures of the 19th century.
He received a permit to build the Difference Engine,





the machine will be able to make tables. He was not able to build it after trying several times and in 1833 he finally gave up his plans.

The history of computers

Georg Scheutz, Swedish printer (1785-1873) built the difference engine using Babbage's plans and in 1854 he presented it in London. The machine received a **gold medal at the First Paris International Exposition** in 1855.

Joseph Jacquard (1752-1834), the builder of the analytic machine, developed the automation of weaving fabric on the loom. The key of his method was the application of a series of cards on which holes were punched so that they composed the required design.

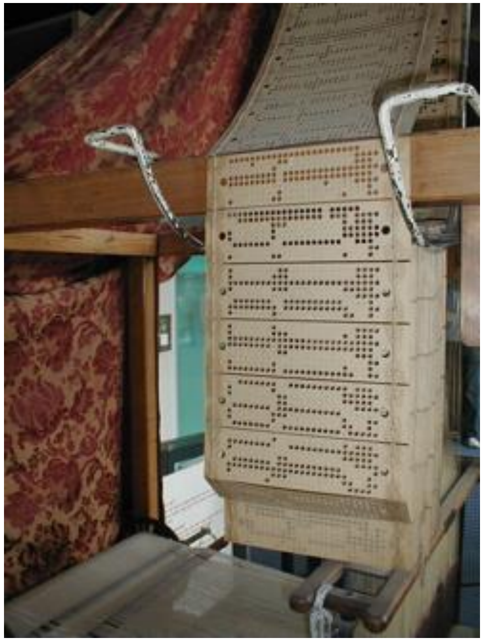
The history of computers

The **analytic machine** was almost perfectly analog. The machine consisted of two parts:

- **Store/memory,** where the variables were placed with which operations had to be made and sums created as the result of other operations were also stored here.

- **Mill**, where sums were put in with which some kind of operations had to be made.

The history of computers



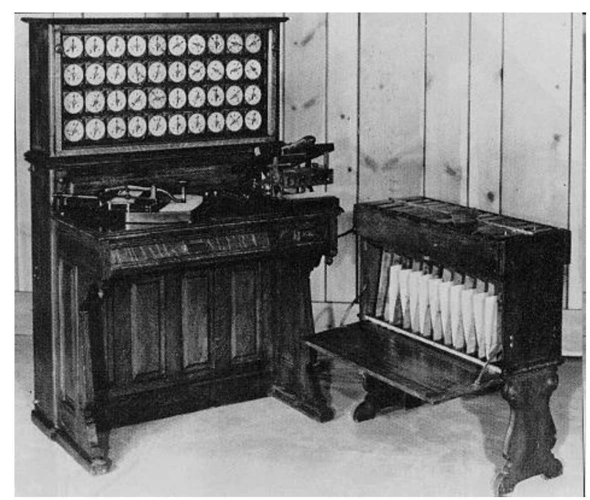
Although due to its complexity he could never build this machine, he is considered the **spiritual father of computing/informatics** because of the ideas developed during planning.

The history of computers

Hermann Hollerich (1860-1929) the Department of Homeland Security of the USA used his punched card machine at the census in 1890.

He made one card for each inhabitant which contained if the person was male or female, white or black, native or foreigner, etc.

He constructed a machine to punch these cards and a simple device to categorize the cards.



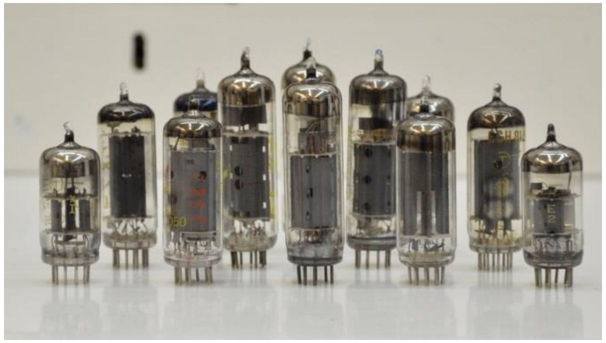
The history of computers

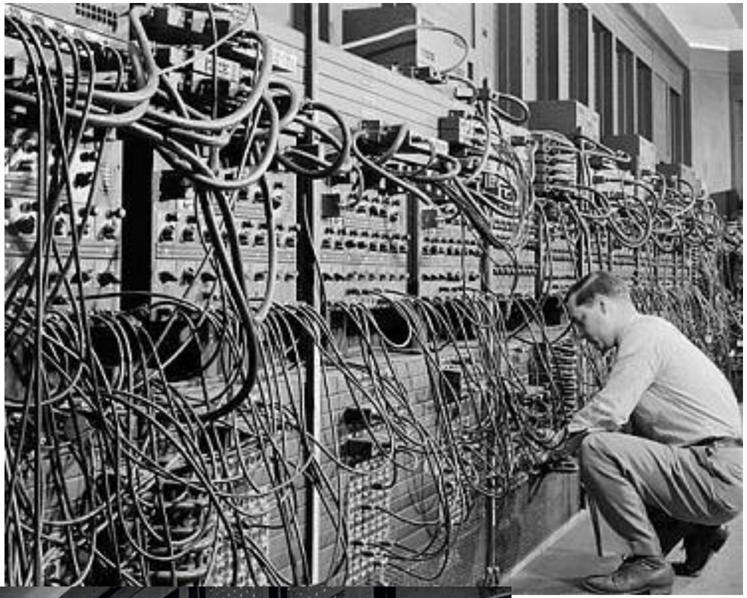
The first generation

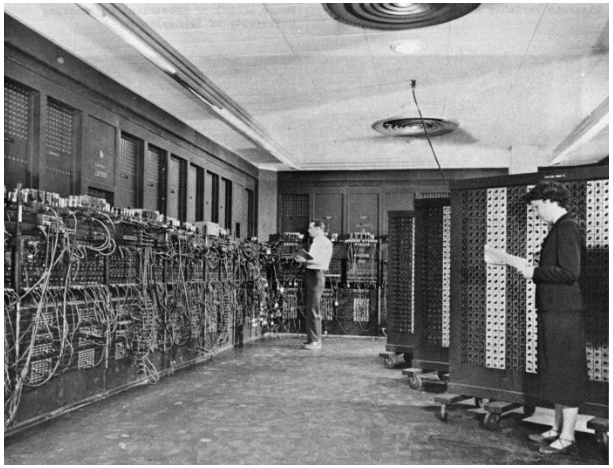
- After the invention of the vacuum tube in 1906, it could be produced in a technically applicable form in the 1930s. Its main advantage was speed.
- The computer called **ENIAC** was made in 1946. 18 thousand vacuum tubes were used for building it. The 30-ton structure consumed 120 – 150 kW electrical energy.
  The input and output of data happened with the help of punch cards.
  It was about thousand times faster than its predecessors.

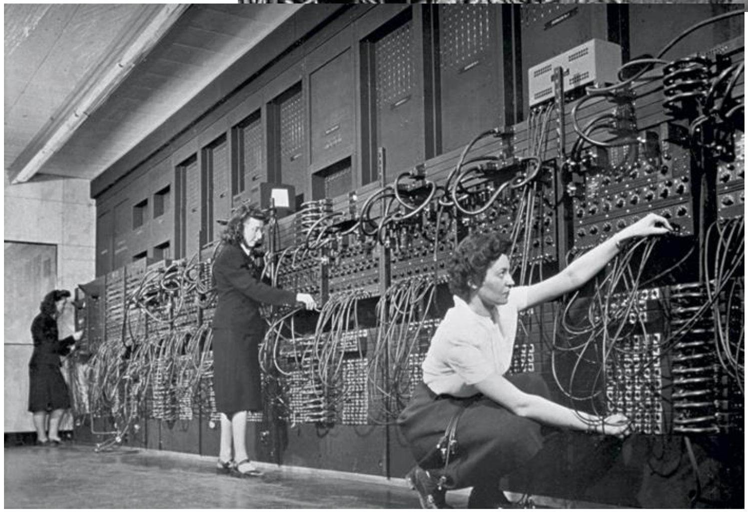
The history of computers

ENIAC









The history of computers

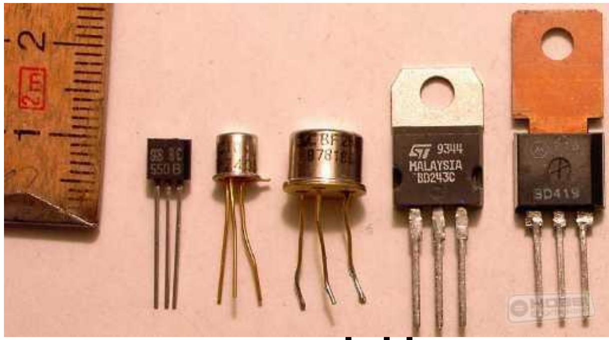
- **ENIAC** was followed by **EDVAC** which was the **first program-controlled, digital** universal machine.
- Its basic principles were developed by **János Neumann** (1903-1957).

These principles were the following:

- The computer has to be **completely electronic**, with a separate **controller** and **executive/performing** unit.
- It has to use **binary numeral system**.
- **Data** and **programmes** have to be placed **in the same interior store**, the memory.
- The computer has to **be universal**.

The **principles** developed by **Neumann** are **guidelines even today**.

The history of computers



Second generation

- The era between the years of 1959 – 65.

The invention of **transistor** facilitated the emergence of the new generation. It meant a huge size reduction, at the same time their energy consumption also decreased significantly. The speed of operation also multiplied.

- The early computers produced by **IBM** – although consisted of 160,000 transistors – made **one million operations per second**. It meant a **six thousand fold increase in speed** compared to tubular machines.

The reliability of machines increased to about thousandfold.

The history of computers

Third generation

- The era between the years of 1965 – 71.
- Due to the **integrated circuit** technique, several thousand circuit elements can be placed in a **single semiconductor chip per square centimeter.**
- The size was further reduced and speed increased.
- Byte- structure and input-output processor appeared.
- Computers could already make several operations parallelly.

The history of computers

- The integrated circuits further decreased the price, size and the number of malfunctions of computers.
- This further increased the demand for computers: by the beginning of the **1970s more than 100,000 large computers** and also more than **100,000 minicomputers were put into operation**
- Today more than 5 million transistors are in processors, none of which go wrong during operation.

The history of computers

- The operation system appeared.
- The first high-level languages were created. ALGOL, BASIC and COBOL were outstanding.

The history of computers

Fourth generation: **the microprocessor**

The complete CPU created in a single semiconductor element is called microprocessor which is placed in a single integrated circuit case.

The **INTEL** company announced the creation of the microprocessor **in 1971**, the unit marked **8008**.

The appearance of microprocessors made it possible that computers could enter everyday life.

The history of computers

Since the appearance of the microprocessor, the performance of computers – not only PCs – doubles every second year, this is Moore's law.

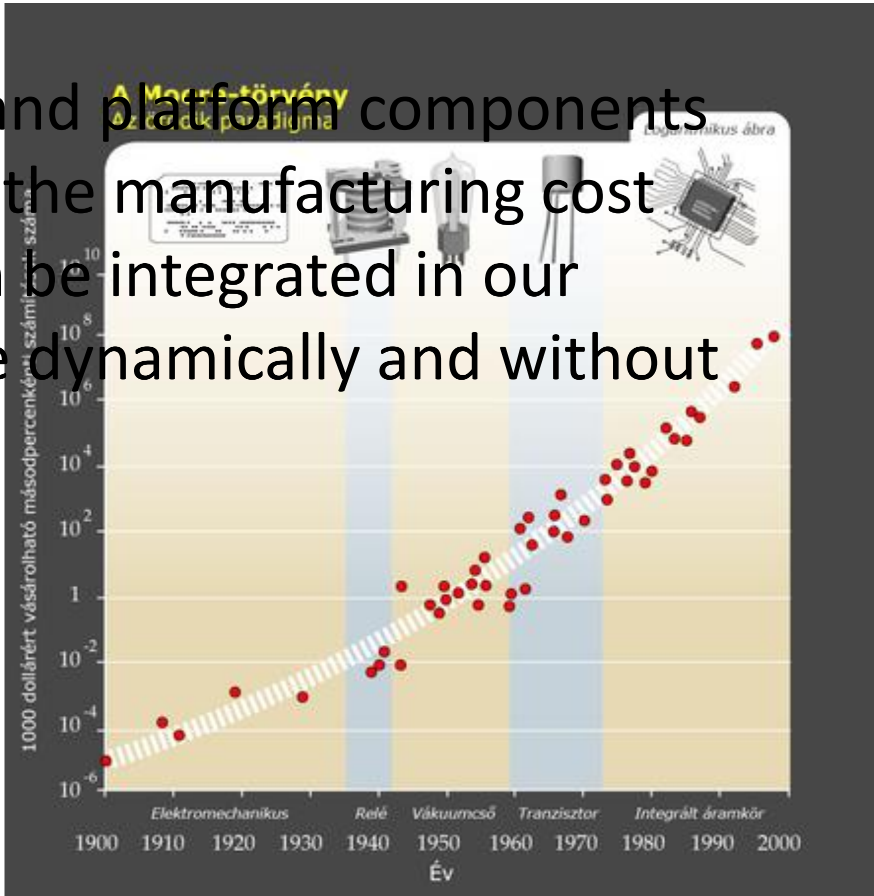
Gordon Moore's article was published in the Electronics Magazine, which predicted that the number of integrated circuits will double every year, with continuous cost reduction.

The prediction which became well-known as Moore's Law made the spread of technology possible in the whole world and by today it is fundamental for fast technological changes. Moore reconsidered his prediction in 1975 and stated that the number of transistors on chips will double approximately every second year.

The history of computers

Besides predicting the increase of the complextiy of the chip (which is measured with the number of transistors on one computer chip), **Moore's Law** also suggests the reduction of costs.

As the silicium-based „spare parts" and platform components continuously increase performance, the manufacturing cost can exponentially decrease, so it can be integrated in our everyday life in larger quantity, more dynamically and without problems.



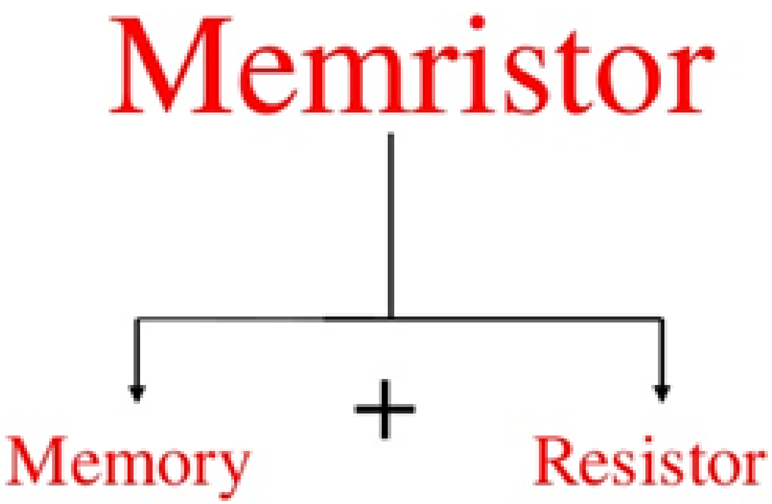
The history of computers

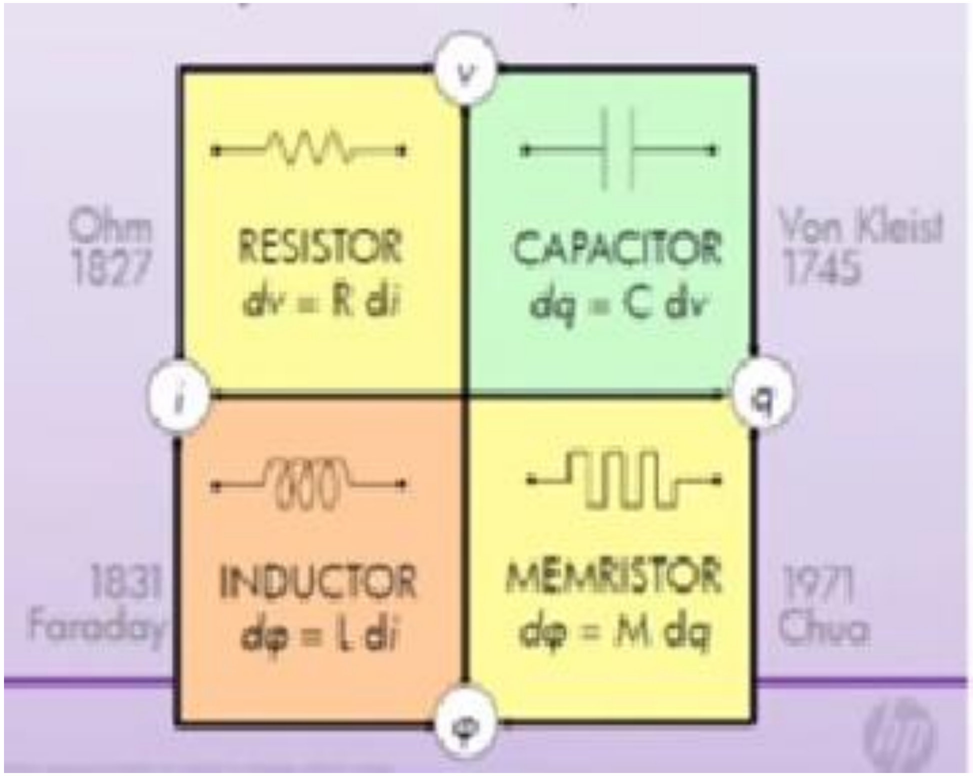
<u>The fifth generation</u> **the future**

- The most significant developments tend to the application of **microprocessors suitable for parallel operation,** but **minituarization** also has an important role.
  The ultimate aim of developments is the **creation of artificial intelligence.**
- The practical application of parallel processing would mean a significant progress, which means that several circuits solve different tasks at the same time. With its help, even the imitation of human thinking would become possible.
- Investigations are carried out to develop optical computers. Instead of electrons, light impulses will carry information in these.

What is MEMRISTOR?

- Fourth fundamental circuit element
- Passive element
- Two terminal device



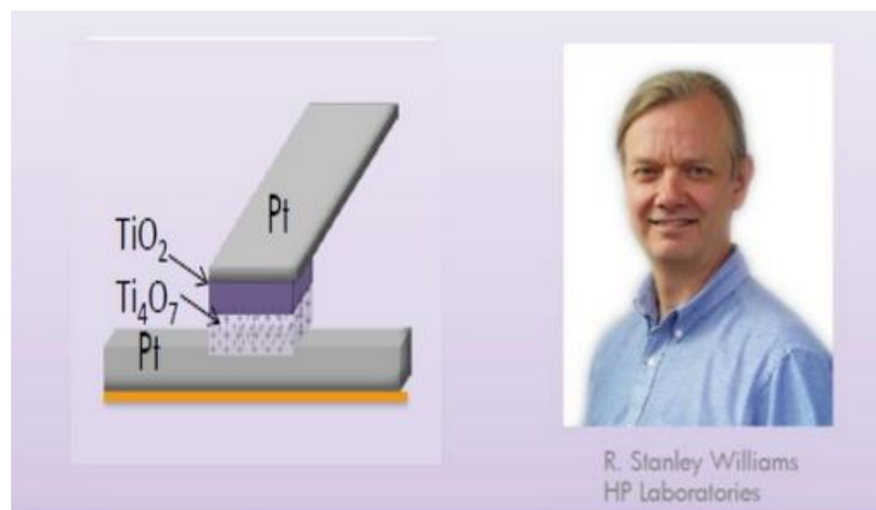


History of Memristor

1971: Leon Chua*, From University of California Berkeley

- He mathematically postulated that based on the relations between the four fundamental circuit variables and the symmetry, there should exist another circuit element that relates the charge and flux

2008: HP – memristor: 3nm



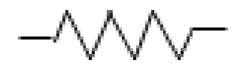
2014: „The Machine project”

4 basic passive circuit elements

Nonlinear | Linear | Local value

Resistor

R



$$v = f(i) \Rightarrow v = Ri \Rightarrow dv = R\,di$$

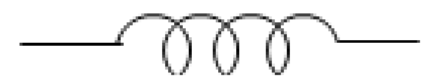
Capacitor

C

$$q = f(v) \Rightarrow q = Cv \Rightarrow dq = C\,dv$$

Inductor

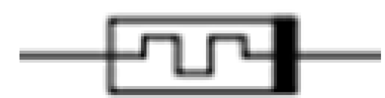
L



$$\phi = f(i) \Rightarrow \phi = Li \Rightarrow d\phi = L\,di$$

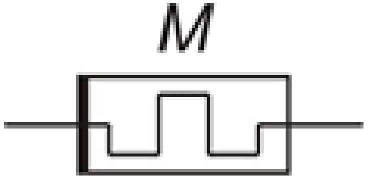
Memristor

M



$$\phi = f(q) \Rightarrow \phi = Mq \Rightarrow d\phi = M\,dq$$

Definition of Memristor

- **MEMRISZTOR is a semiconductor whose resistance varies as a function of flux and charge. This allows it to remember what has passed through the circuit.**
- Memristor is a portmanteau of “memory resistor”. It is a passive device with two terminals, where the magnetic flux is related to the amount of passed electric charge through the device.
- Symbol of a memristor: 

- Characterised by MEMRISTANCE: $$M(q) = \frac{d\varphi}{dq}$$
- Unit: Ω (ohm)

Memristor definition

For a charge-controlled memristor,

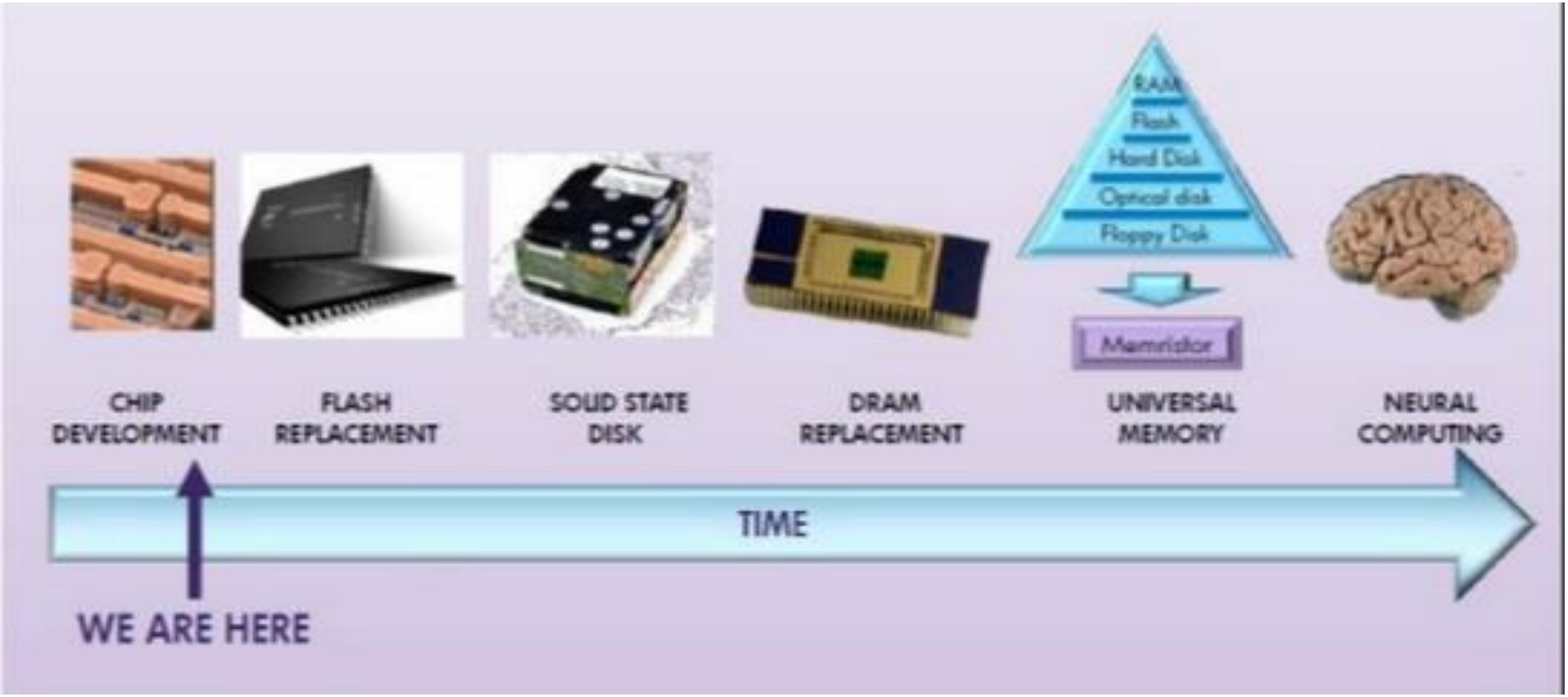
$$\phi = f(q)$$

differentiating yields: $\frac{d\varphi}{dt} = \frac{df(q)}{dq} \cdot \frac{dq}{dt}$

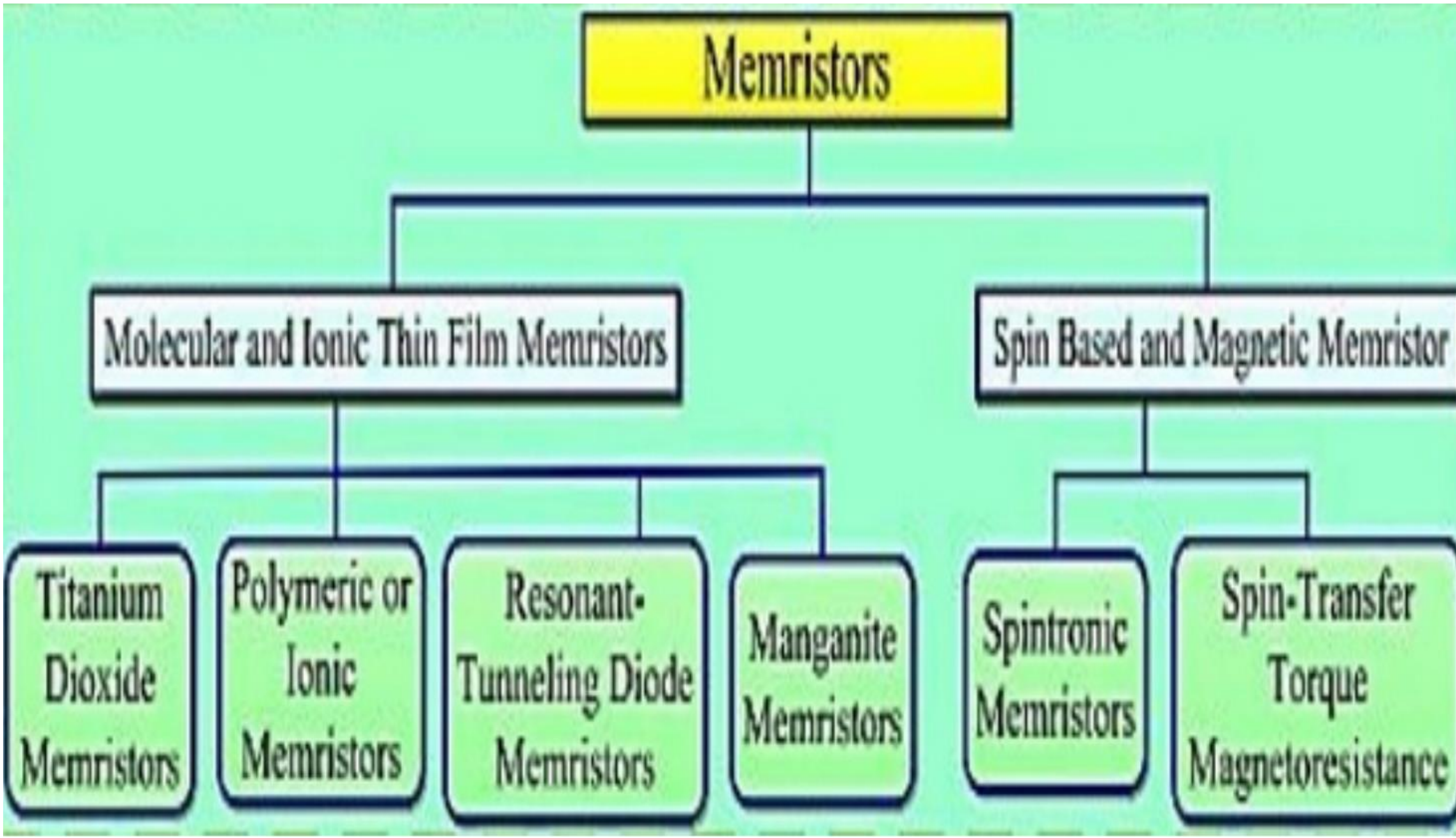
having the voltage as $v(t) = \frac{d\varphi}{dt}$ and the current as $i(t) = \frac{dq}{dt}$ can be rewritten as:

$v(t) = M(q)\, i(t)$ where $M(q) = \frac{df(q)}{dq}$.

Memristor opportunities

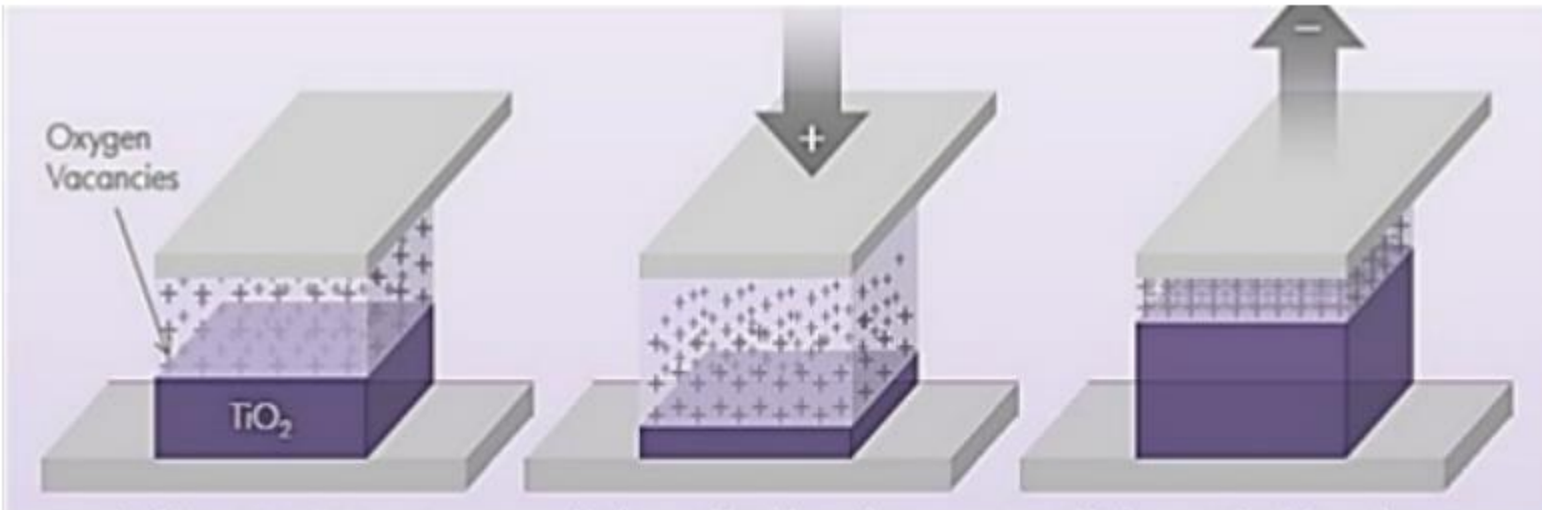


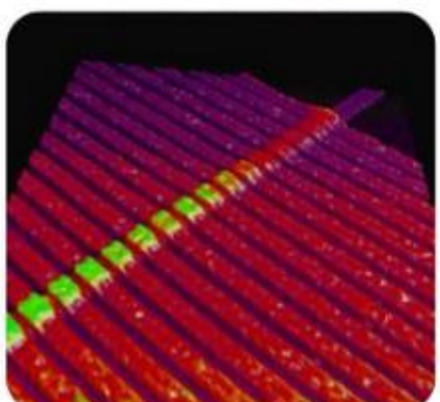
Memristor Fabrication

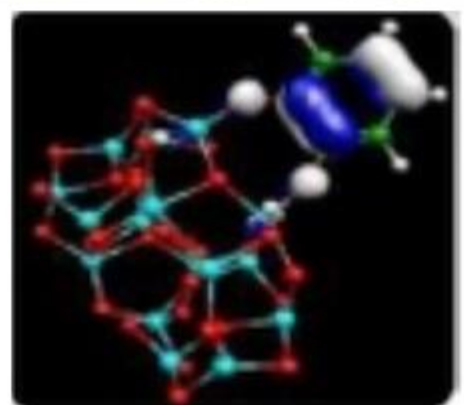


Molecular and Ionic Thin Film Memristors

- Titanium dioxide memristors (HP)

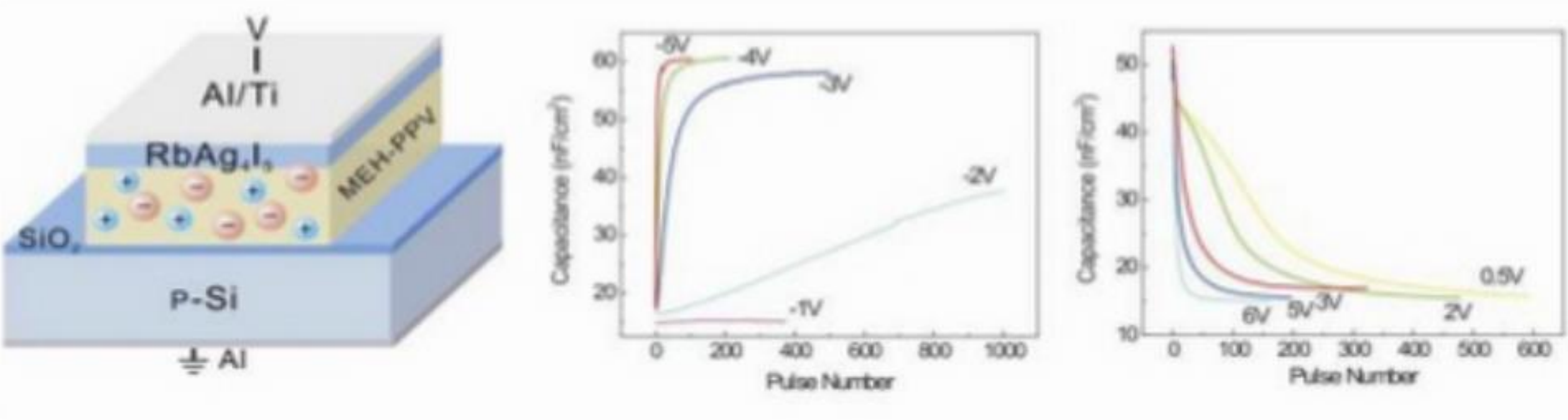






Molecular and Ionic Thin Film Memristors

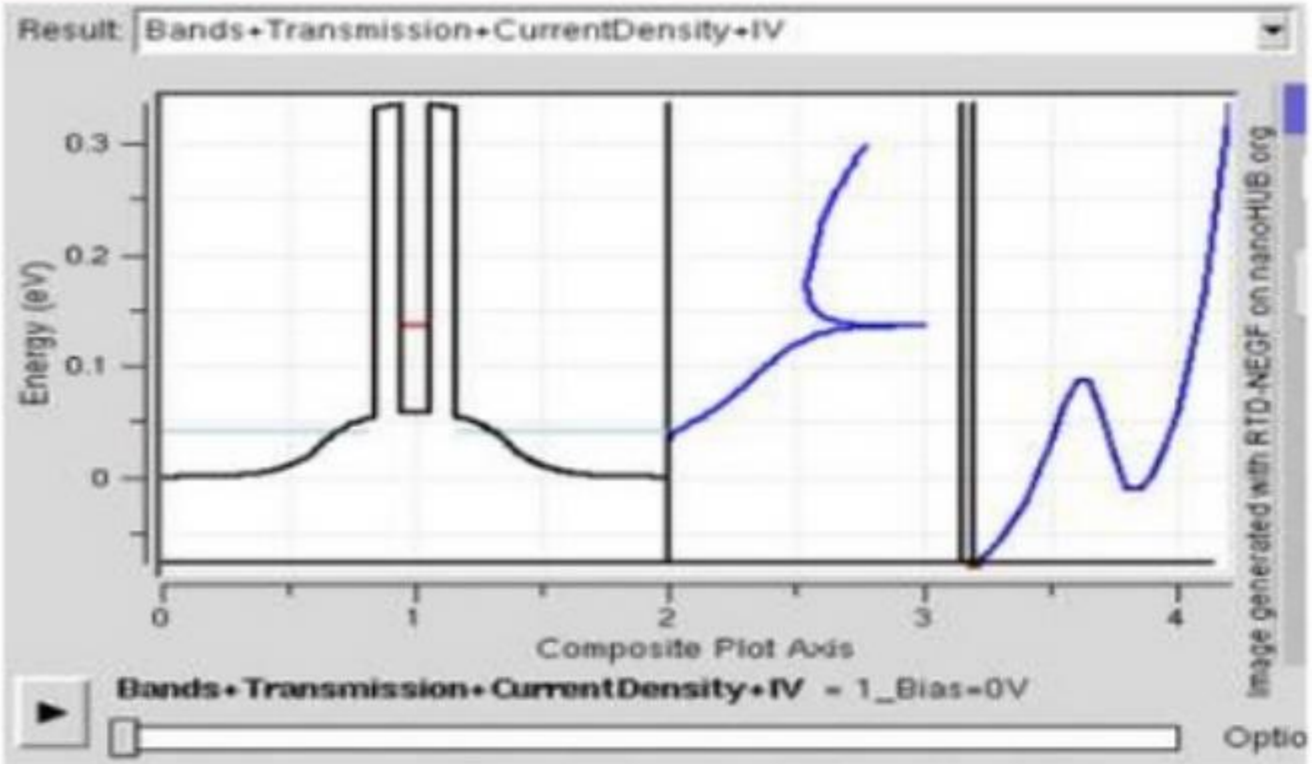
- Polymetric memristors



In 2004, Juri H. Krieger and Stuart M. Spitzer published a paper "Non-traditional, Non-volatile Memory Based on Switching and Retention Phenomena in Polymeric Thin Films" at the IEEE Non-Volatile Memory Technology Symposium, describing the process of dynamic doping of polymer and inorganic dielectric-like materials in order to improve the switching characteristics and retention required to create functioning nonvolatile memory cells. Described is the use of a special passive layer between electrode and active thin films, which enhances the extraction of ions from the electrode.

Molecular and Ionic Thin Film Memristors

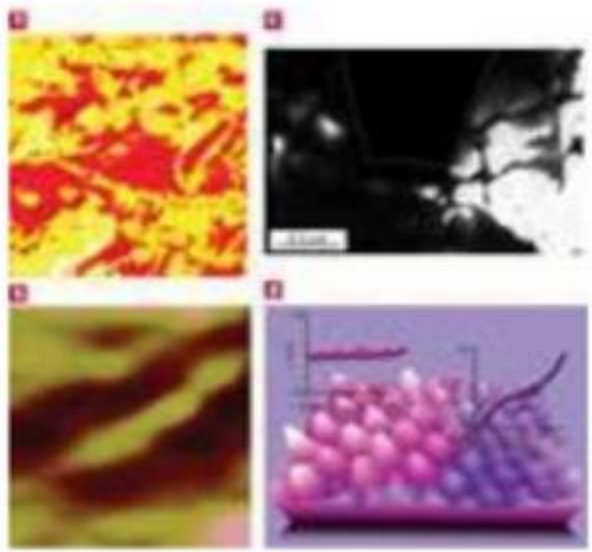
- Resonant tunneling dioda memristor

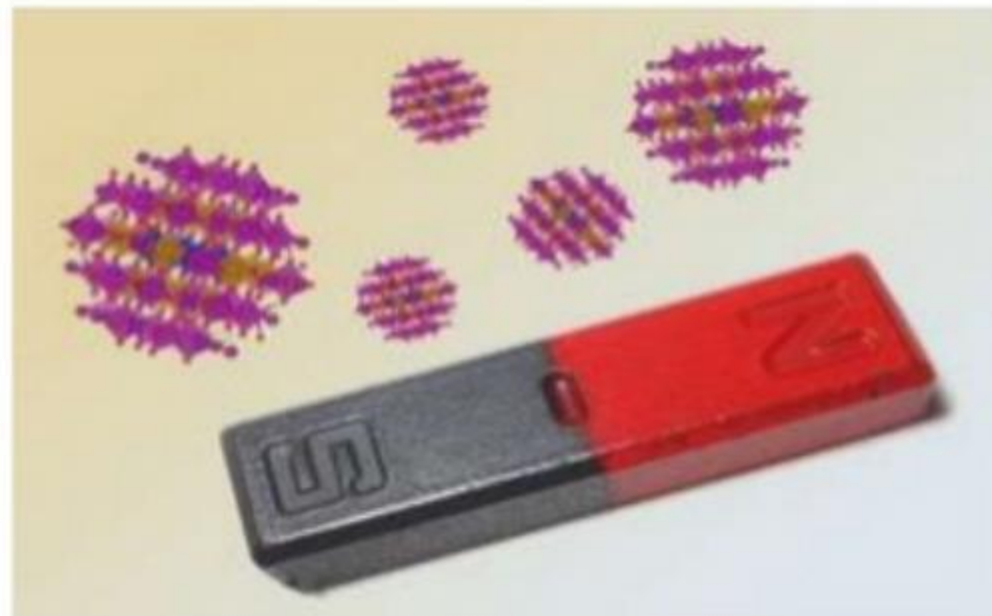


In 1994, F. A. Buot and A. K. Rajagopal of the U.S. Naval Research Laboratory demonstrated that a 'bow-tie' current-voltage (I-V) characteristics occurs in AlAs/GaAs/AlAs quantum-well diodes containing special doping design of the spacer layers in the source and drain regions, in agreement with the published experimental results. This 'bow-tie' current-voltage (I-V) characteristic is characteristic of a memristor although the term memristor was not explicitly used in their papers. No magnetic interaction is involved in the analysis of the 'bow-tie' I-V characteristics.

Molecular and Ionic Thin Film Memristors

- Manganite memristive systems



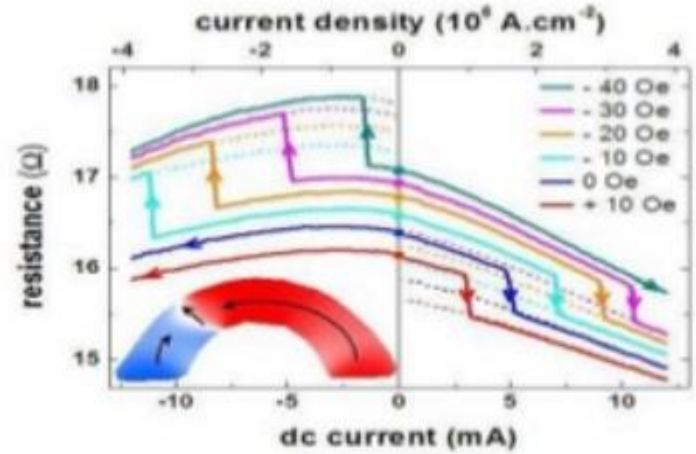


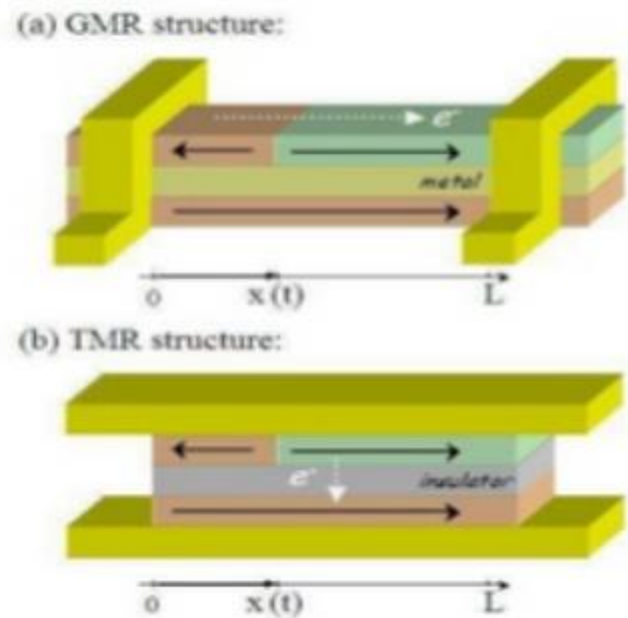
Although not described using the word "memristor", a study was done of bilayer oxide films based on manganite for non-volatile memory by researchers at the University of Houston in 2001. Some of the graphs indicate a tunable resistance based on the number of applied voltage pulses similar to the effects found in the titanium dioxide memristor materials described in the Nature paper "The missing memristor found

Spin based and Magnetic Memristors

- Spin memristive systems – Spintronic memristor

Yiran Chen and Xiaobin Wang, researchers at disk-drive manufacturer Seagate Technology, in Bloomington, Minnesota, described three examples of possible magnetic memristors in March, 2009 in IEEE Electron Device Letters. In one of the three, resistance is caused by the spin of electrons in one section of the device pointing in a different direction than those in another section, creating a "domain wall", a boundary between the two states. Electrons flowing into the device have a certain spin, which alters the magnetization state of the device. Changing the magnetization, in turn, moves the domain wall and changes the device's resistance.



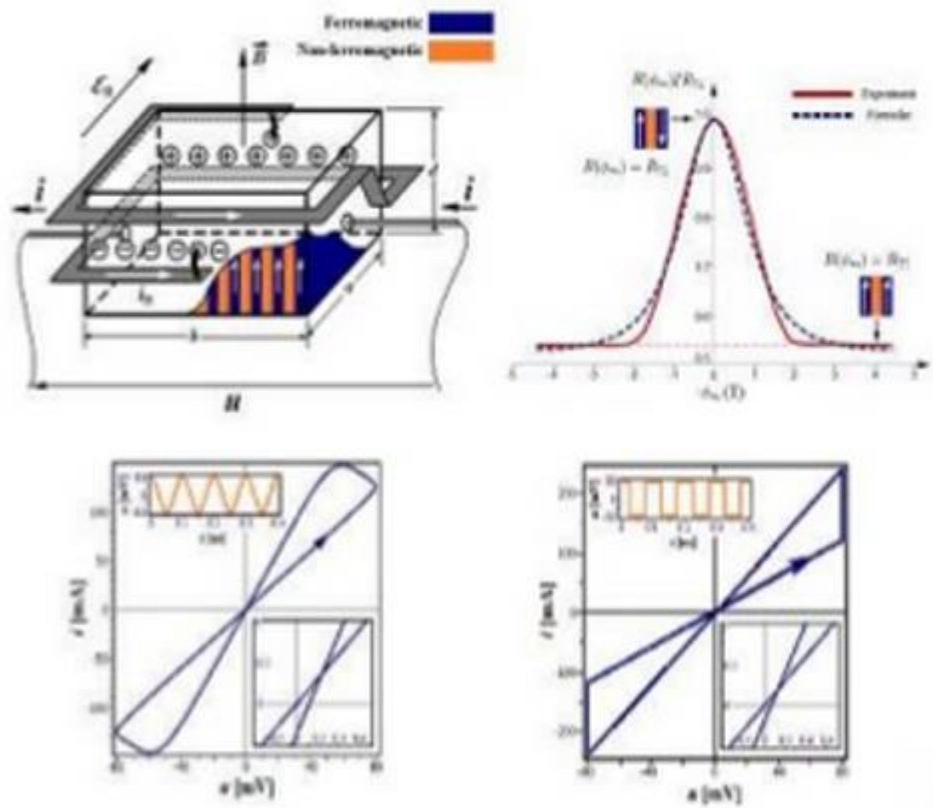


Spin based and Magnetic Memristors

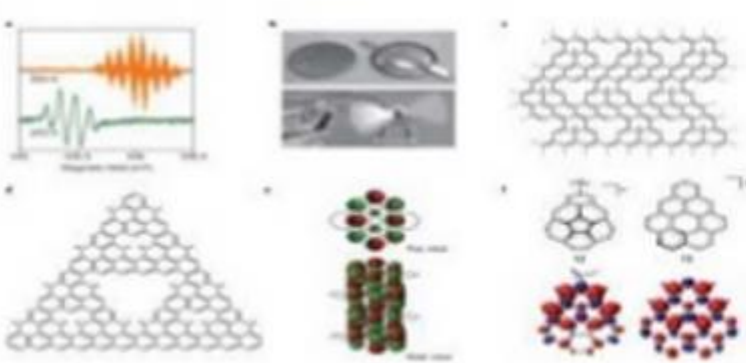
- Spin memristive systems – Spintronic memristor

A fundamentally different mechanism for memristive behavior has been proposed by Yuriy V. Pershin and Massimiliano Di Ventra in their paper "Spin memristive systems".

The mechanism of memristive behavior in such structures is based entirely on the electron spin degree of freedom which allows for a more convenient control than the ionic transport in nanostructures. When an external control parameter (such as voltage) is changed, the adjustment of electron spin polarization is delayed because of the diffusion and relaxation processes causing a hysteresis-type behavior.

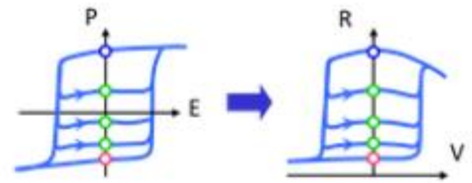


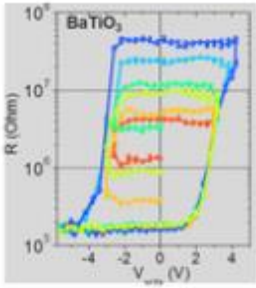
Spin-Valve Memristive System

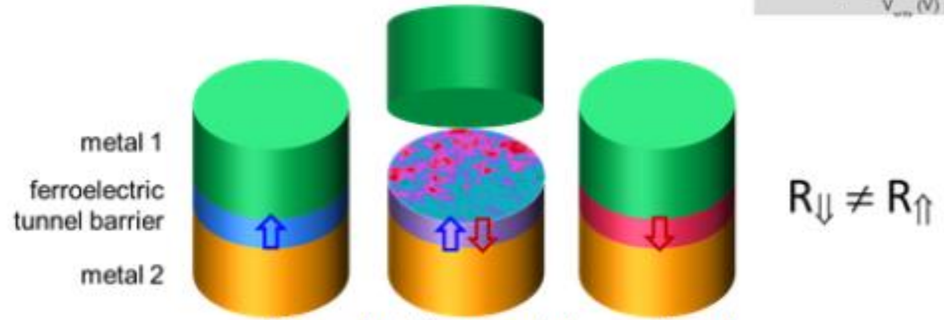


Ferroelectric Memristors

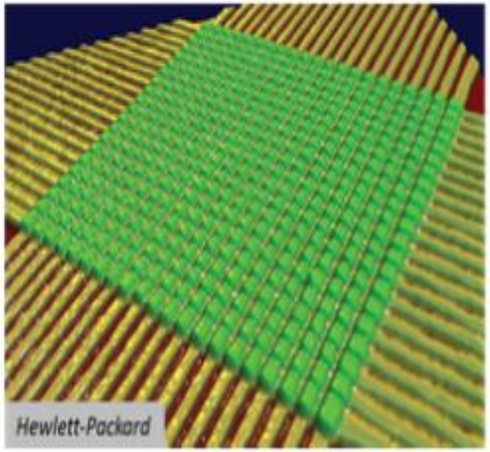
- The ferroelectric memristors is based on a thin ferroelectric barrier sandwiched between two metallic electrodes.
- Switching the polarization of the ferroelectric material by applying a positive or negative voltage across the junction can lead to a two order of magnitude resistance variation: $R_{ON} << R_{OF}$ (an effect called Tunnel Electo- Resistance)
- In general, the polarisation does not switch abruptly

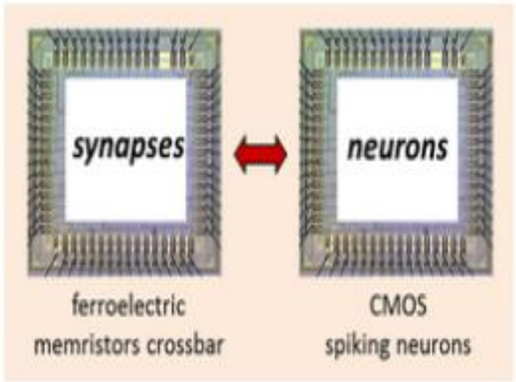






Ferroelectric memristor : principle





Potential applications

A comparison of performance parameters of different memory technologies

	Traditional technologies				Emerging technologies			
			Improved Flash					
	DRAM	SRAM	NOR	NAND	FeRAM	MRAM	PCM	Memristor
Knowledge level	mature		advanced		product		advanced	early stage
Cell elements	1T1C	6T	1T		1T1C	1T1R	1T1R	1M
Half pitch (F) (nm)	50	65	90	90	180	130	65	3-10
Smallest cell area	6	140	10	5	22	45	16	4
Read time (ns)	< 1	< 0.3	< 10	< 50	< 45	< 20	< 60	< 50
Write/Erase time (ns)	< 0.5	< 0.3	10^5	10^6	10	20	60	< 250
Retention time (years)	seconds	N/A	> 10	> 10	> 10	> 10	> 10	> 10
Write op. Voltage (V)	2.5	1	12	15	0.9-3.3	1.5	3	< 3
Read op. Voltage (V)	1.8	1	2	2	0.9-3.3	1.5	3	< 3
Write endurance	10^{16}	10^{16}	10^5	10^5	10^{14}	10^{16}	10^9	10^{15}
Write energy (fJ/bit)	5	0.7	10	10	30	1.5×10^5	6×10^3	< 50
Density ($Gbit.cm^{-2}$)	6.67	0.17	1.23	2.47	0.14	0.13	1.48	250
Voltage scaling	fairly scalable					no	poor	promising
Highly scalable	major technological barriers			poor		promising	promising	promising

Classification of computers

- Two main types
  - Analog
  - Digital computer
- **Analog** computers deal with **the mathematical description of physical phenomena.**
  Can be beneficially used e.g. for solving bioligical tasks, their **accuracy** and **speed is limited**.
- **Digital** computers divide, translate tasks into discrete values (numbers, digits), and the prescribed operations are made on these.

Classification of compute

- Personal computer (PC)
  - The well-known desktop computer. It is able to run operation systems and users‘ programmes in itself. Connected in a network, it can share its storing, processing and printing resources.
- Notebook
  - The portable version of desktop computer.
- Tablet PC
  - The hand-held version of notebook.

Classification of computers

How and what for people use the iPad? Briefly we can summarize general experiences, that iPad and other similar machines are primarily the most suitable for passive media consumption (reading, watching videos) and also for gaming.

- **PDA/hand-held computer**
  It is a miniaturized computer, usually runs with a simplified operating system of the Microsoft, suitable for limited tasks.

Classification of computers

- **PNA** (Portable Navigation Assistant)

A device particularly made for navigation, usually suitable also for playing MP3, MP4.

- **Multimedia players**
  MP3, (MP4), MP5

Classification of computers

- **<u>Network computers:</u>**

  Their primary task is recording data, providing information.

  <u>Terminals:</u>

  – A working station consisting of a monitor and keyboard. Usually used connected in network, for low computational tasks. Terminals use the resources of servers.

We distinguish:

- ***<u>Intelligent terminal:</u>***

  An input-output device connected to the central computer which is also suitable for preparing, processing data.

Classification of computers

- ***Smart terminal:***

  It provides functions similar to intelligent terminals, but has fewer local resources.

- ***Simple-minded terminal:***

  An input-output device connected to the central computer which is suitable exclusively for contacting the central computer. It does not have its own processor, memory or mass storage, usually consists of one monitor and an input unit.

Classification of computers

Classification of computers

- ***<u>Large computers</u>***
  - Supercomputer
  - Mainframe
  - Minicomputer

Classification of computers

- ***Supercomputer***
  - The fastest and most expensive type of computer
  - Target computers built individually, which are used for the fastest possible execution of a given, usually high computational programme.
  - Field of use:
    - making weather forecasts,
    - simulating nuclear explosions,
    - making the effects of top-quality animations of movies

Classification of computers

- ***Mainframe***
  - A huge computer which includes the performance of loads of desktop computers. It is usually used as a network server, and for industrial calculations.
  - Machine used for serving several users connected through terminals, for processing a large amount of data
  - Processing is made on the central machine
  - Are able to run many programmes fast at one time
  - Its use is typical in a corporate environment, it handles the data bases, correspondence of the given company
  - Its cost, depending on the performance demand can even approximate the manufacturing costs of a supercomputer




Classification of computers

- **<u>Minicomputer</u>**
  - Similar to mainframe computers concerning their tasks and mode of access, but its performance is smaller.
  - Used for data processing in small and medium-sized companies where serving maximum 100-200 users is needed.
  - Lower performance, significantly cheaper than mainframe systems

Classification of softwares

Computer software can be put into categories based on common function, type, or field of use. There are three broad classifications:

- **Application software** is the general designation of computer programs for performing tasks. Application software may be general purpose (word processing, web browsers, etc.) or have a specific purpose (accounting, truck scheduling, etc.). Application software contrasts with system software.
- **System software** is a generic term referring to the computer programs used to start and run computer systems including diverse application software and networks.
- **Computer programming tools**, such as compilers and linker, are used to translate and combine computer program source code and libraries into executable RAMs (programs that will belong to one of the three said)

Classification of softwares

Copyright status

- free software,
- open source software,
- public domain software,
- copylefted software,
- noncopylefted free software,
- lax permissive licensed software,
- GPL-covered software,
- the GNU operating system,
- GNU programs,
- GNU software,
- FSF-copyrighted GNU software,
- nonfree software,
- proprietary software,
- freeware,
- shareware,
- private software and
- commercial software.

Classification of softwares

Free software

- Free software is software that comes with permission for anyone to use, copy and distribute, either verbatim or with modifications, either gratis or for a fee. In particular, this means that source code must be available. "If it's not source, it's not software." If a program is free, then it can potentially be included in a free operating system such as GNU, or free versions of the Linux system.

Classification of softwares

Open source software

- Open source software is software with its source code made available under a certain license to its licensees. It can be used and disseminated at any point, the source code is open and can be modified as required. The one condition with this type of software is that when changes are made users should make these changes known to others. One of the key characteristics of open source software is that it is the shared intellectual property of all developers and users. The Linux operating system is one of the best known examples of a collection of open source software

Classification of softwares

Copylefted software

- Copylefted software is free software whose distribution terms ensure that all copies of all versions carry more or less the same distribution terms. This means, for instance, that copyleft licenses generally disallow others to add additional requirements to the software (though a limited set of safe added requirements can be allowed) and require making source code available. This shields the program, and its modified versions, from some of the common ways of making a program proprietary. Some copyleft licenses block other means of turning software proprietary.

Copyleft is a general concept. Copylefting an actual program requires a specific set of distribution terms. Different copyleft licenses are usually “incompatible” due to varying terms, which makes it illegal to merge the code using one license with the code using the other license. If two pieces of software use the same license, they are generally mergeable.

Classification of softwares

Non-copylefted free software

- Noncopylefted free software comes from the author with permission to redistribute and modify and to add license restrictions. The X Window System illustrates this approach. The X Consortium releases X11 with distribution terms that make it noncopylefted free software.

Classification of softwares

Shareware

- Shareware is software that comes with permission to redistribute copies, but says that anyone who continues to use a copy is required to pay. Shareware is not free software, or even semi-free. For most shareware, source code is not available; thus, the program cannot be modified. Shareware does not come with permission to make a copy and install it without paying a license fee, including for nonprofit activity.

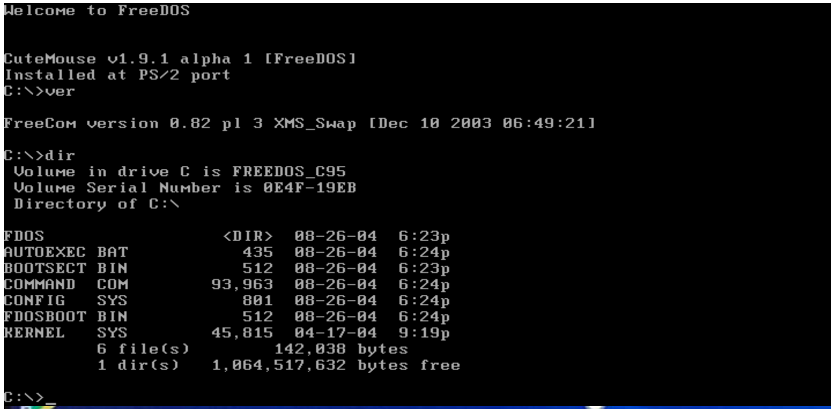
Classification of softwares

Freeware

- Like shareware, freeware is software available for download and distribution without any initial payment. Freeware never has an associated fee. Things like minor program updates and small games are commonly distributed as freeware. Though freeware is cost free, it is copyrighted, so other people can't market the software as their own.

Grouping Operating Systems by dimensions

1D Operation System – DOS



2D Operation System – Windows

3D Operation System

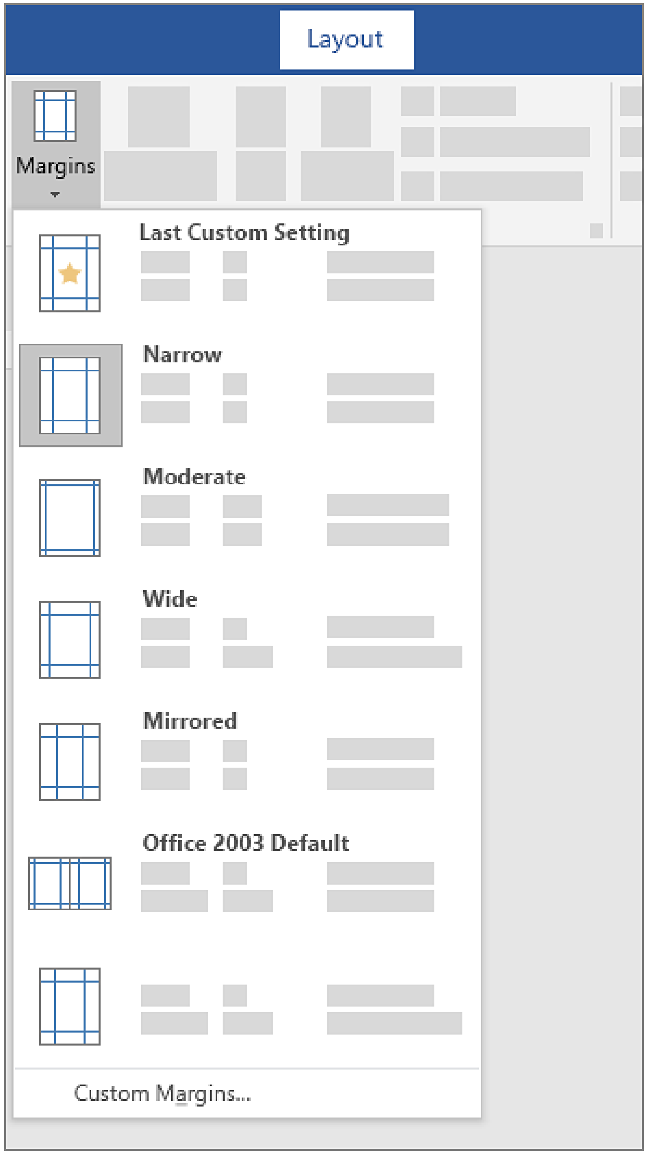
- MaxWhere

Using Microsoft Word program

In Word, you can customize or choose predefined margin settings. Word automatically sets a one-inch page margin around each page.

You also can set margins for facing pages, allow extra margin space to allow for document binding, and change how margins are measured.

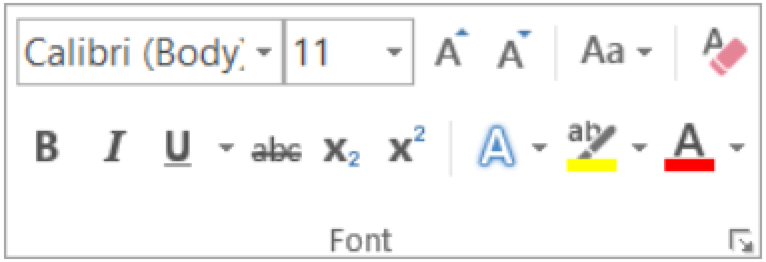
1. Select Layout > Margins.
2. Select the margin configuration you want.
   If you don't see the configuration you want, select Custom Margins to define your own margins



Using Microsoft Word program

Follow these steps to add and format text in Word.

- Add text
  - Place the cursor where you want to add the text.
  - Start typing.
- Format text
  - Select the text you want to format.
  - Select an option to change the font, font size, font color, or make the text bold, italics, or underline etc.



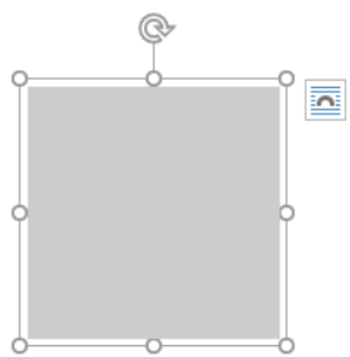
Using Microsoft Word program

Insert Pictures:

- Select **Insert** > **Pictures** for a picture on your PC.
- Select **Insert** > **Online Pictures** for a picture that's on the web.

Resize or move pictus:

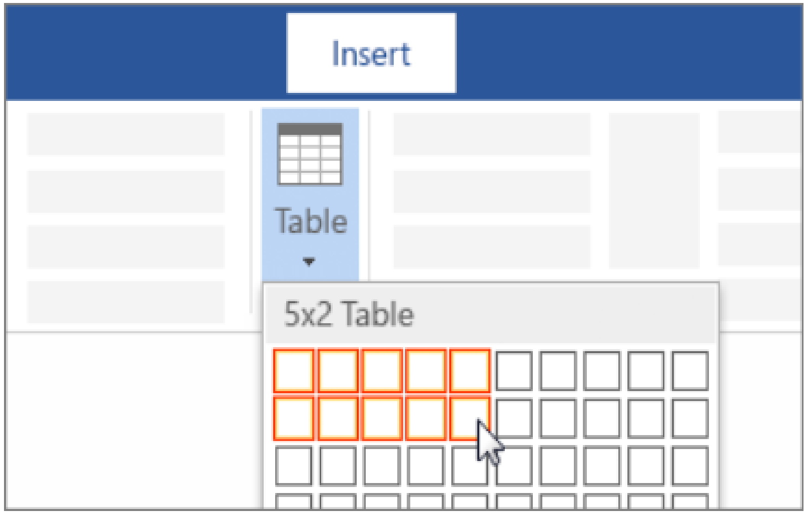
- To resize a picture, select the picture and drag a corner handle.
- To wrap text around a picture, select the picture, and then select a wrapping option.



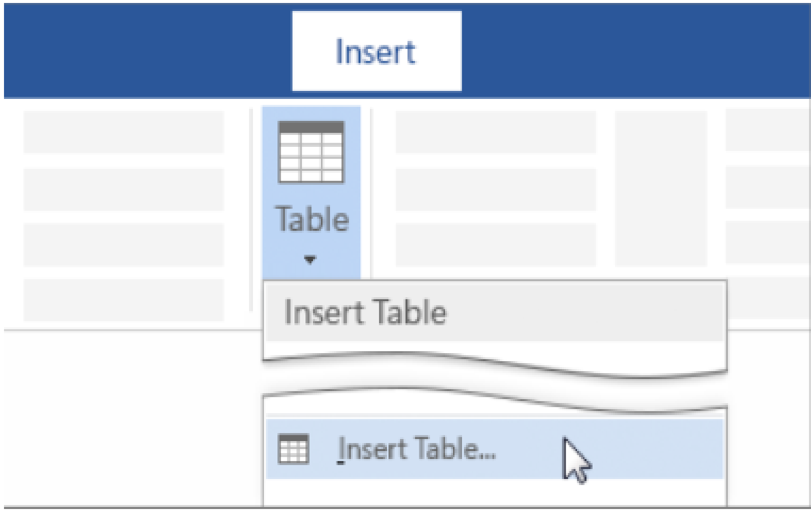
Using Microsoft Word program

Insert a table

- For a basic table, click Insert > Table and move the cursor over the grid until you highlight the number of columns and rows you want.



- For a larger table, or to customize a table, select Insert > Table > Insert Table.

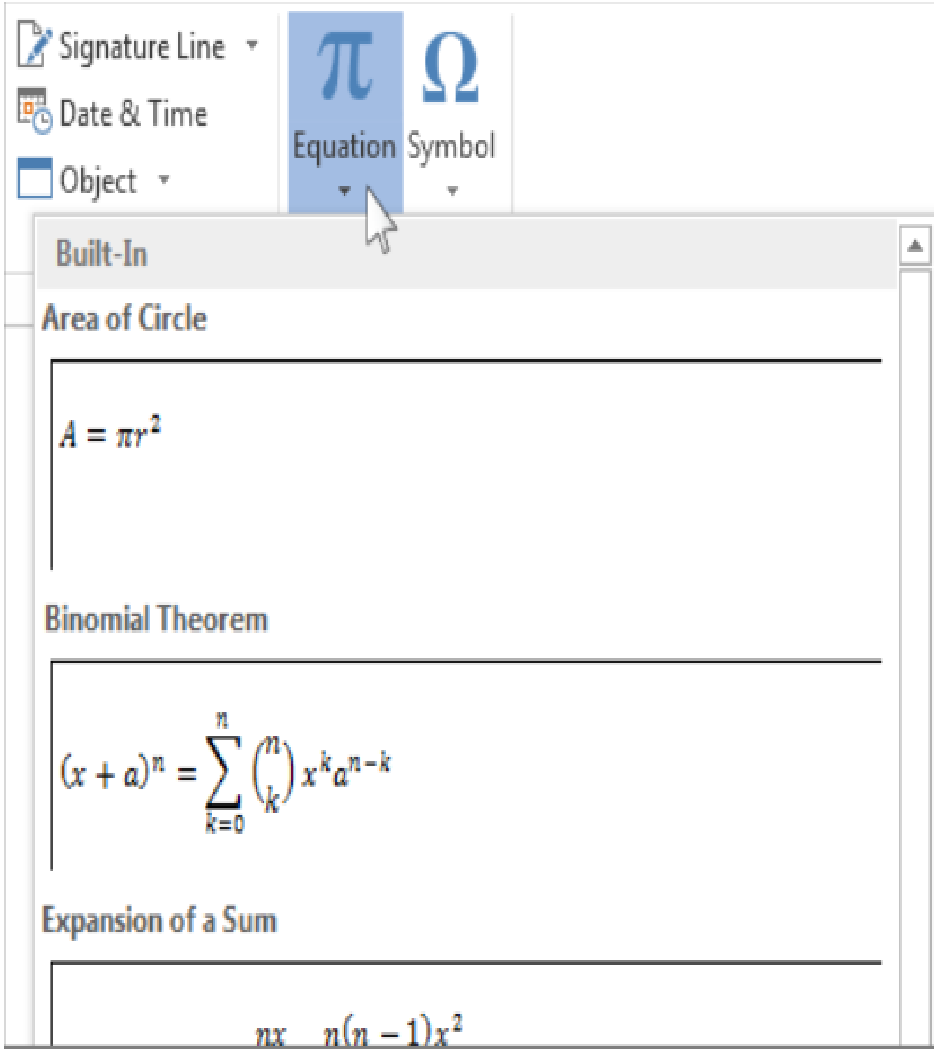


Using Microsoft Word program

Equations

Office has equations that you can readily insert into your documents. If the Office built-in equations don't meet your needs, you can edit, change the existing equation, or write your own equation from scratch.

- Choose Insert > Equation and choose the equation you want from the gallery.

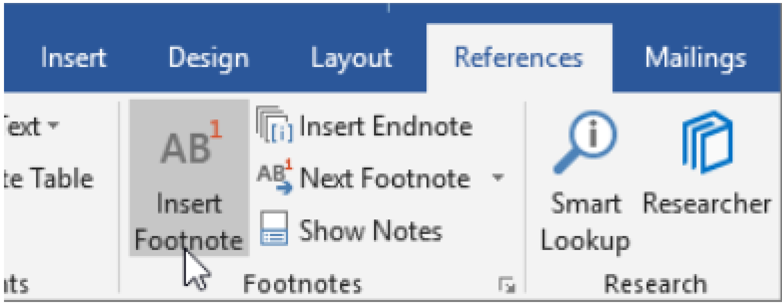


Using Microsoft Word program

Insert footnotes and endnotes

Footnotes appear at the bottom of the page and endnotes come at the end of the document. A number or symbol on the footnote or endnote matches up with a reference mark in the document.

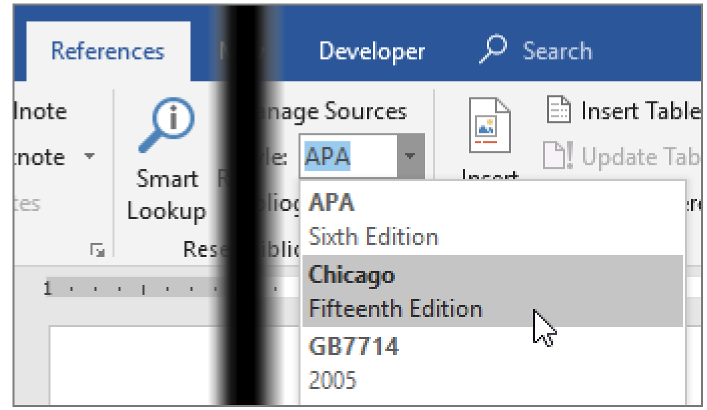
1. Click where you want to reference to the footnote or endnote.
2. On the References tab, select Insert Footnote or Insert Endnote.
3. Enter what you want in the footnote or endnote.
4. Return to your place in the document by double-clicking the number or symbol at the beginning of the note.



Using Microsoft Word program

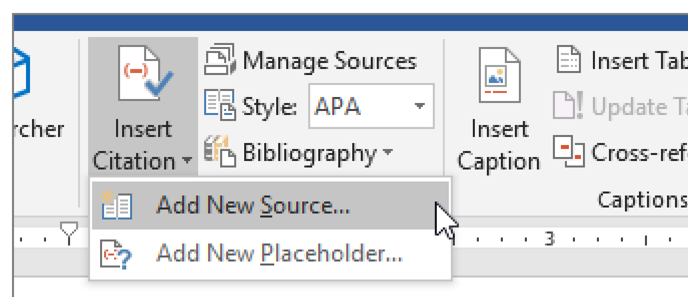
Create a bibliography, citations, and references

- Put your cursor at the end of the text you want to cite.
- Go to References > Style, and choose a citation style.



On the References tab choose a citation style from the Style list.

- Select Insert Citation



Using Microsoft Word program

- Choose Add New Source and fill out the information about your source.

Once you've added a source to your list, you can cite it again:

- – Put your cursor at the end of the text you want to cite.
- – Go to References > Insert Citation, and choose the source you are citing.

Using Microsoft Word program

Create a bibliography

With cited sources in your document, you're ready to create a bibliography.

- Put your cursor where you want the bibliography.
- Go to References > Bibliography, and choose a format.

Remark: If you cite a new source, add it to the bibliography by clicking anywhere in the bibliography and selecting **Update Citations and Bibliography**.

Using Microsoft Word program

Share a document

When you share your document with others and give them permission to edit, everyone's changes are made in the same document.

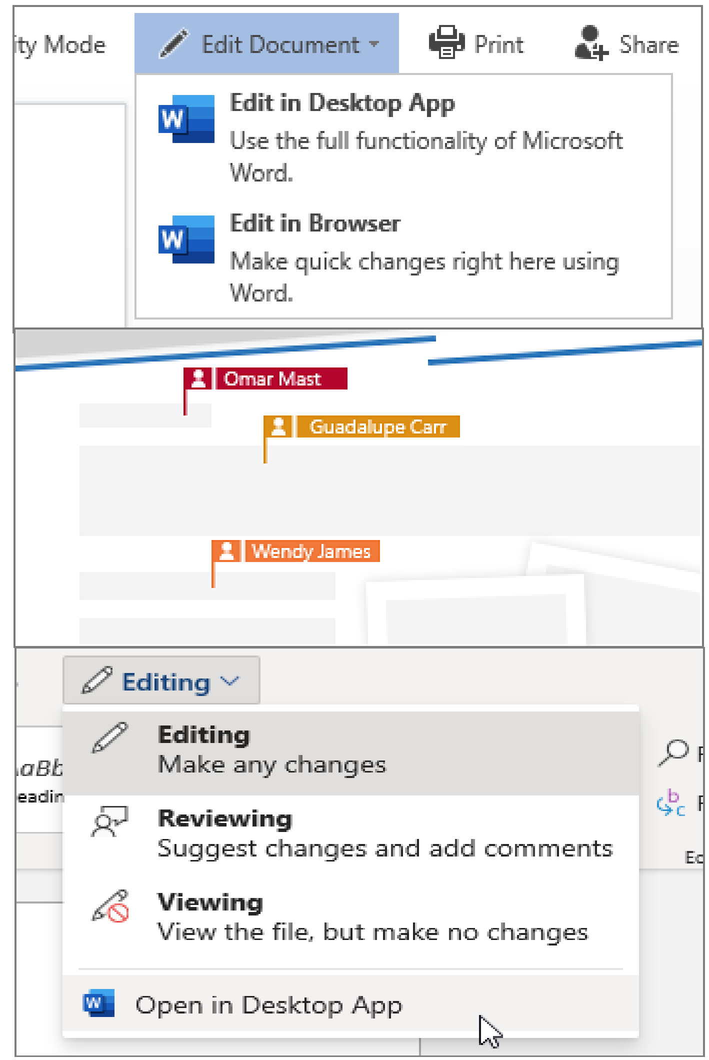
1. In the top right corner, above the ribbon, click Share.
2. Save your document in OneDrive, if it's not already there.
3. Enter email addresses of the people you want to share with, and make choices for permission you want to allow.
4. Type a message if you want, and click Send.

Remark: The people you're sharing with will get mail from you, with a link to your document.

Using Microsoft Word program

Collaborate on Word documents with real-time co-authoring.

- When someone shares a Word document with you, the email you receive includes a link that opens the document in your web browser: in Word for the web. Select **Edit Document** > **Edit in Browser.**
- If anyone else is working on the document, you'll see their presence and the changes they're making. We call this coauthoring, or real-time collaboration.
- From here, if you'd rather work in your Word app, switch from **Editing** to **Open in Desktop App**, near the top of the window.



Using Microsoft PowerPoint program

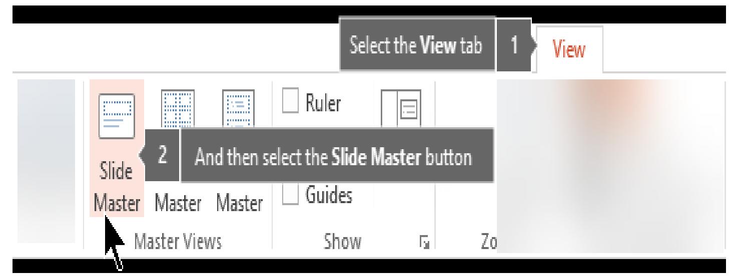
With PowerPoint on your PC, Mac, or mobile device, you can:

- Create presentations from scratch or a template.
- Add text, images, art, and videos.
- Select a professional design with PowerPoint Designer.
- Add transitions, animations, and cinematic motion.
- Save to OneDrive, to get to your presentations from your computer, tablet, or phone.
- Share your work and work with others, wherever they are.

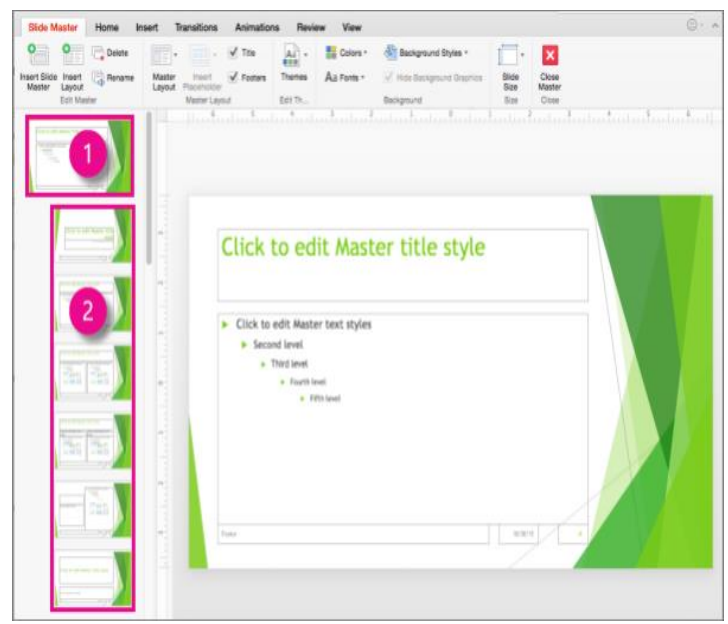
Using Microsoft PowerPoint program

Slide Master

- When you want all your slides to contain the same fonts and images (such as logos), you can make those changes in one place—the Slide Master, and they'll be applied to all your slides. To open Slide Master view, on the View tab, select Slide Master:



- The master slide is the top slide in the thumbnail pane on the left side of the window. The related layout masters appear just below the slide master:



Using Microsoft PowerPoint program

- When you edit the slide master, all slides that are based on that master will contain those changes. However, the majority of changes that you make will most likely be to the layout masters related to the master.

- When you make changes to layout masters and the slide master in Slide Master view, other people working in your presentation (in Normal view) can’t accidentally delete or edit what you’ve done.

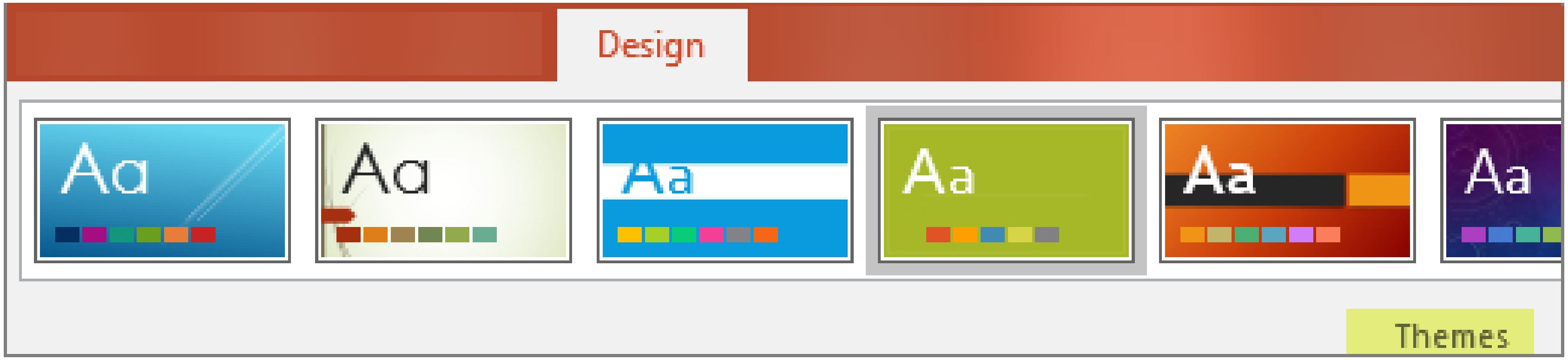
  Conversely, if you're working in Normal view and find that you're unable to edit an element on a slide (such as, "why can't I remove this picture?") it may be because the thing you're trying to change is defined on the slide master or a layout master. To edit that thing, you must switch to Slide Master view.

Using Microsoft PowerPoint program

Themes

- A theme is a palette of colors, fonts, and special effects (like shadows, reflections, 3-D effects, and more) that complement one another. A skilled designer created each theme in PowerPoint. We make those pre-designed themes available to you on the Design tab in Normal view.

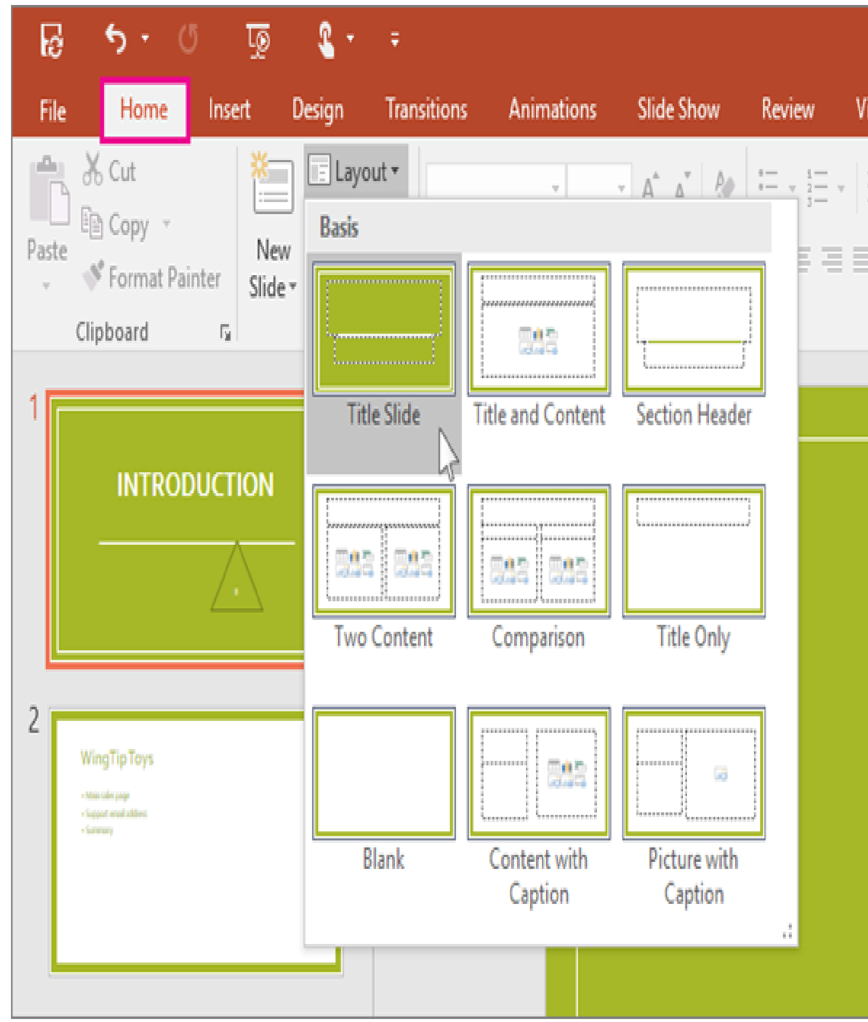
- Every theme you use in your presentation includes a slide master and a related set of layouts. If you use more than one theme in your presentation, you'll have more than one slide master and multiple sets of layouts.



Using Microsoft PowerPoint program

Slide Layouts

- You change and manage slide layouts in Slide Master view. Every theme has a several slide layouts. You choose the layouts that best match your slide content; some are better for text and some are better for graphics.
- In Normal view, you'll apply the layouts to your slides
- Each slide layout is set up differently — with different types of placeholders in different locations on each layout.
- Every slide master has a related slide layout called **Title Slide Layout**, and each theme arranges the text and other object placeholders for that layout differently, with different colors, fonts and effects. The following pictures contrast the title slide layouts for two themes: first the **Basis** theme and then the **Integral** theme.



Using Microsoft PowerPoint program

Animations

Slide transition

A slide transition is the visual effect that occurs when you move from one slide to the next during a presentation. You can control the speed, add sound, and customize the look of transition effects.

- Select the slide you want to add a transition to.
- Select the Transitions tab and choose a transition. Select a transition to see a preview.
- Select Effect Options to choose the direction and nature of the transition.
- Select Preview to see what the transition looks like.

Using Microsoft PowerPoint program
Animations

Animate text or objects

- You can animate the text, pictures, shapes, tables, SmartArt graphics, and other objects in your PowerPoint presentation.
- Effects can make an object appear, disappear, or move. They can change an object's size or color.

Using Microsoft PowerPoint program

Animations

Add animations to text, pictures, shapes, and more in your presentation:

1. Select the object or text you want to animate.
2. Select Animations and choose an animation.
3. Select Effect Options and choose an effect.

Manage animations and effects:

There are different ways to start animations in your presentation:

1. On Click: Start an animation when you click a slide.
2. With Previous: Play an animation at the same time as the previous animation in your sequence.
3. After Previous: Start an animation immediately after the previous one happens.
4. Duration: Lengthen or shorten an effect.
5. Delay: Add time before an effect runs.

Using Microsoft PowerPoint program

Animations

Add more effects to an animation

- Select an object or text with an animation.
- Select Add Animation and choose one.

Change the order of animations

- Select an animation marker.
- Choose the option you want:
  - Move Earlier: Make an animation appear earlier in the sequence.
  - Move Later: Make an animation occur later in the sequence.

Add animation to grouped objects

You can add an animation to grouped objects, text, and more.

- Press Ctrl and select the objects you want.
- Select Format > Group > Group to group the objects together.
- Select Animations and choose an animation.

Using Microsoft PowerPoint program

Share a presentation by saving it to the cloud and sending it to others

- Select Share.
- Select where to save your presentation to the cloud.
- Choose a permission level.
- Select Apply.
- Enter names and a message.
- Select Send.

Practice

You can find practical tasks in the network folder below:
O: (Tutors) \ Department Materials \ Electrical Networks \ Ildiko Horvath \ Tasks \ Microsoft Word or Microsoft PowerPoint

Open the file and complete the task based on the template

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Thank you for your attention!